Engineering Library
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# The Engineer.

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VOL. CXXXIII.—No. 3447] LONDON: FRIDAY EVENING, JANUARY 20, 1922 [PRICE ONE SHILLING BY IRELAND POST 1s. 3d.

## PUBLIC NOTICES

**Civil Engineer for Railway Construction** required by the GOVERNMENT of the GOLD COAST, for two tours, each of 12 to 18 months' service, with possible extension. Salary £600 per annum, rising by annual increments of £30 to £720. Outfit allowance of £60 is paid on first appointment. Free single quarters or an allowance in lieu, and first-class passages. Liberal leave in England on full salary.

Candidates, preferably single, age 25 to 35, must be fully qualified civil engineers, who have had practical experience on railway survey and construction.—Apply at once, in writing, giving age and brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Gold Coast 11,266. 7189

**Civil Engineer Required** by the GOVERNMENT of ZANZIBAR for one tour of 29/30 months' service, as an ASSISTANT ENGINEER in the PUBLIC WORKS DEPARTMENT, with a prospect of permanency. Salary £400 per annum, rising by annual increments of £20 to £500 per annum, and thence by annual increments of £25 to £600 per annum, payable locally in rupees at 15 rupees to the £. Free quarters and first-class passages. Liberal leave in England on full salary.

Candidates, single and under 35, must have had good practical experience on roads, buildings, and other public works, and preferably have passed the A.M.I.C.E. or an equivalent exempting examination.—Apply at once, in writing, giving age and brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Zanzibar 11,288. 7196

**Deputy Resident Engineer** REQUIRED by the GOVERNMENT of NIGERIA for LAGOS and APAPA HARBOUR WORKS, for two tours of 12 to 18 months' service, with possible extension. Salary £1200 per annum, rising by annual increments of £50 to £1400 per annum, with a duty allowance of £240 per annum. Free quarters and first-class passages. Liberal leave in England on full salary.

Candidates, not over 45 years of age, must be duly qualified civil engineers, and have had a wide experience on an engineer's or contractor's staff in the actual construction of harbours and dock works, both by contract and departmentally.—Apply at once, in writing, giving age and brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Nigeria 11,281. 7197

**Alteration to Hot Water** SUPPLY for Heating and Domestic Purposes at Winchester Poor Law Institution.

Also for NEW MACHINERY in Laundry.

Deposit £3 3s.

F. FAITHFULL,
Clerk to the Guardians.

105, High-street, Winchester,
13th February, 1922. 7224

**County Borough of Southampton.**

NEW PUMPS, CORPORATION WHARF

The Corporation invite TENDERS for DISMANTLING existing PUMPS and SUPPLYING and ERECTING THREE NEW 18in. CENTRIFUGAL PUMPS at the Corporation Wharf, Chapel, Southampton.

Particulars may be obtained at the Borough Engineer's Office, Southampton, upon production of the Borough Treasurer's receipt for a deposit of £1 1s.

Deposits will be returned after the Council have dealt with the Tenders, to those who have submitted bona fide Tenders.

Sealed Tenders, endorsed "Tender for Pumps," must be delivered at the Town Clerk's office by Twelve o'clock at noon on the 4th February, 1922.

The Corporation do not bind themselves to accept any Tender.

R. R. LINTHORNE,
Town Clerk.

16th January, 1922. 7200

**Corporation of Calcutta**

WATERWORKS EXTENSIONS CONTRACTS, 1921.

The Corporation of Calcutta are prepared to receive TENDERS for:—

CONTRACTS I. to VI., consisting of the SUPPLY and LAYING in a prepared trench of THIRTY MILES of RIVETED STEEL PIPE in the following sizes:—60in., 54in., 51in., 48in., 42in., 36in., and 33in.

Plans can be seen and copies of specification, Tender, &c., obtained on or after January 20th, 1922.

In ENGLAND, from the Consulting Engineers, Messrs. 84, George-Moore and La Trobe-Bateman, MM. Inst. C.E., 91, Victoria-street, Westminster, S.W. 1; and

In INDIA, from J. R. Coats, Esq., B.Sc., M. Inst. C.E., Chief Engineer to the Corporation of Calcutta, Central Municipal Offices, Calcutta.

The sum of £5 or Rs.75 respectively will be charged for each set of four copies of the contract documents, which sum will be returned on receipt of a bona fide Tender, prepared in triplicate.

Two copies of all Tenders, from wherever emanating, to be delivered at the offices of the Consulting Engineers in London at or before Twelve Noon on March 16th, 1922, when they will be officially opened in the presence of such tenderers as care to attend. The third copy to be dispatched by registered post on or before the same date, addressed to the Chief Engineer, Corporation of Calcutta, Central Municipal Offices, Calcutta.

Tenders to be in sealed covers and superscribed "Corporation of Calcutta, Tender for Steel Mains."

The Corporation do not bind themselves to accept the lowest or any Tender.

Tenderers may submit separate Tenders for alternative proposals.

B. V. RAMIAH,
Secretary to Corporation.

Calcutta,
January, 1922. 7146

**Great Southern and Western**

RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY and DELIVERY of about 160 TONS of STEEL WORK for ten short-span bridges.

Specifications and drawings can be obtained from Mr. J. F. Sides, M. Inst. C.E., Chief Engineer, Great Southern and Western Railway, Inchicore, Dublin, on payment of £2 2s., which will be refunded on receipt of a bona fide Tender.

The Directors do not bind themselves to accept the lowest or any Tender.

Tenders must be delivered on or before the 13th February, 1922, to the undersigned.

ROBERT CRAWFORD,
Secretary.

Kingsbridge Terminus, Dublin. 7219

## The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

The Iron, Steel, Coal and Engineering Trades in 1921.—No. III.

Friction Lifters for Drop Stamps.—No. II.

The Electrification of the St. Gothard Railway.

The Vacuum Airship.

Corrugation of Tramway Rails.

Electrical Engineering in 1921.

Railway Signals.

Water Supply in 1921.

Physical and Optical Societies' Exhibition.—No. II.

Worm Gear Generating Machine.

## PUBLIC NOTICES

**Government of Bombay.**

BOMBAY DEVELOPMENT DIRECTORATE.
AMBERNATH INDUSTRIAL AREA.
SEWAGE SCHEME.

The Director of Development is prepared to receive TENDERS up to Twelve Noon on Wednesday, 15th March, 1922, for the CONSTRUCTION and RUNNING for six months of a SEWAGE INSTALLATION capable of dealing with the sewage and sullage water of an area containing 8000 people. The installation must be capable of dealing with about 1,10,000 gallons of liquid per day, and should not include the provision of sewers, which are being arranged for separately.

Tenders should be accompanied by earnest money of Rs. 500 (five hundred only), which will be returned to the unsuccessful tenderers and will be retained in the case of successful tenderer as part of the security deposit.

The Director of Development does not bind himself to accept the lowest or any Tender.

For particulars apply to the SUPERINTENDING ENGINEER, No. 3 Project Division, Directorate Building, Old Custom House-yard, Fort, Bombay.

N.B.—Ambernath is a new satellite town for the development of manufacturing industries and is situated on the G.I.P. Railway, 40 miles north-east of Bombay, India. 7140

**Salford Union Infirmary, Hope,**

PENDLETON.

TENDERS are INVITED for INDUCED DRAUGHT FAN and CONNECTIONS for the Boiler-house at the above Infirmary.

Copies of specification and drawing may be obtained on application to the undersigned (on payment of 10s. 6d., which will not be returnable) on or after Monday, January 16th, 1922.

Sealed Tenders to be delivered on or before January 30th, 1922.

E. H. INCHLEY,
Clerk to the Guardians.

Poor Law Offices,
Eccles New-road, Salford,
13th January, 1922. 7192

**Tenders are Invited by the** Government of New South Wales for the CONSTRUCTION of the SUPERSTRUCTURE and SUB-STRUCTURE of a CANTILEVER BRIDGE across Sydney Harbour from Dawes Point to Milson's Point, embracing a main span of 1600ft. in the clear, centre to centre of main piers, or 2600ft. centre to centre of anchor piers. The total length of bridge included in Tender is 3816ft., centre to centre of abutments. The deck of the bridge is to include four lines of railway, and a roadway 35ft. wide, between main trusses; and cantilevered outside the main trusses on the western side, a footway 15ft. wide, and on the eastern side a motor roadway 18ft. wide. Copies of specification, including plans, general conditions and schedule of quantities may be obtained on application to the undersigned.

To give any information required by tenderers, Mr. J. J. C. Bradfield, Chief Engineer, will be in London during June and July, 1922, address care of the undersigned.

Tenders in accordance with the specification must reach the Under Secretary for Public Works, Sydney, not later than 31st October, 1922.

AGENT-GENERAL
FOR NEW SOUTH WALES.

Australia House, Strand, London, W.C. 2,
December, 1921. 7086

**The Danish State Railways** invite TENDERS for the SUPPLY of about 831·3 TONS of FISH-PLATE BOLTS, RAIL SPIKES, CLIPS, and LOCKING WASHERS.

Specifications and drawings can be obtained on payment of 10 Danish Crowns on application to 1, Banekontor, Gl. Kongevej 1, Copenhagen B., where Tenders will be received not later than 2 p.m. on the 10th of February, 1922. 7157

## PUBLIC NOTICES

**The Great Indian Peninsula**

RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely:—

| No. | | Fee for Specification. |
|---|---|---|
| 1. | HELICAL and VOLUTE SPRINGS .... | £1 |
| 2. | MILD STEEL BARS, SECTIONS, &c. (for Bridge Renewals) ..... | £1 |
| 3. | MANTLES for LAMPS ..... | 5s. |

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Helical and Volute Springs," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 31st January, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C. 2,
London, 18th January, 1922. 7222

**Truro Port and Harbour.**

DREDGING.

The Truro City Council, acting as the Truro Port and Harbour Authority, invite TENDERS for DREDGING MUD alongside the quays and at other parts of the upper portions of the navigable portions of the Truro River, and its DISPOSAL on land in process of reclamation. Further particulars may be obtained from the undersigned, to whom Tenders, endorsed "Dredging," should be sent not later than 5 p.m. on Wednesday, 8th February, 1922.

F. A. BARNES,
City Engineer and Surveyor.

Municipal Buildings, Truro,
12th January, 1922. 7185

**Burma Railways.**

THREE ASSISTANT ENGINEERS.

The Directors are prepared to receive APPLICATIONS (by letter only) from duly qualified candidates for APPOINTMENT as ASSISTANT ENGINEERS in their Way and Works Department in India.

Candidates must be between 22 and 28 years of age, active, of good physique, with a thorough knowledge of instrument work and well trained in ordinary engineering knowledge. They must have had at least three years' training in a recognised Engineering College and not less than one year's practical experience. Preference will be given to Associate Members of the Institution of Civil Engineers or those who hold an exempting degree.

SALARY.—Rs. 550, rising by annual increments of Rs. 50 to Rs. 1100 per calendar month, without exchange compensation allowance. Commencing salary, if aged 24 or below, Rs. 550, but if more than 24 and the selected candidate has had war service, the commencing salary would be Rs. 50 per month more for each year over that age up to a maximum of Rs. 650. Men wounded in the war would be acceptable provided they are fit for the work

TERMS.—A three years' agreement in the first instance, first-class free passage to Burma and home again on satisfactory termination of services.

The selected candidate will be required to pass a strict medical examination by the Company's Consulting Physician before final appointment.

Applications, giving a full record of candidate's career in chronological order (stating their age, and whether married or single), and showing where they obtained their general and technical education and practical experience as assistant civil engineers, with dates in each case, must be addressed to the undersigned not later than Tuesday, 7th February, 1922.

W. HOME, C.I.E.,
Managing Director.

199, Gresham House,
Old Broad-street, London, E.C. 2.
Dated 17th January, 1922. 7194

## PUBLIC NOTICES

**The Rohilkund and Kumaon**

RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of:—

MATERIALS for the CONSTRUCTION of 100 Four-wheeled Covered GOODS WAGONS;
400 AXLE-BOXES for Ditto;

as per specifications to be seen at the Company's offices.

Tenders, addressed to the undersigned and marked "Tender for Wagons," or as the case may be, are to be lodged not later than Noon on Friday, the 10th day of February, 1922.

For each specification a fee of 10s. will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
E. A. NEVILLE,
Secretary.

237, Gresham House, Old Broad-street,
London, E.C. 2,
18th January, 1922. 7227

## SITUATIONS OPEN

WANTED, ENGINEER for Blast-furnace Plant. Must be experienced with Electric Power.—Address, stating age, experience, and salary required, 7095, The Engineer Office. 7095 A

WANTED, Experienced MACHINERY SALESMAN for India by Calcutta Firm of Engineers. Public school boy preferred. Five-year agreement. Pay commencing Rs. 600 a month. No married men will be considered.—Write, Z. A. 571, c/o Deacon's, Leadenhall-street, London. 7216 A

WANTED for Engineering Works, MAN Accustomed to Advertising and Propaganda Work generally.—Address in confidence, stating age, full particulars of experience and salary required, P4757, The Engineer Office. P4757 A

WANTED, POWER-HOUSE ENGINEER, with thorough experience of construction, maintenance and repairs of Steam Turbines up to 5000 K.W., Condensers and Auxiliaries; also good theoretical knowledge of station economy, operating practice and some experience of high-tension generators and switchgear. Three years' contract for tropical Brazil at attractive salary. Previous experience abroad desirable. Single man preferred, not under 35 years of age.—Box 916, c/o Judd's, 97, Gresham-street. 7208 A

ASSISTANT REQUIRED by Consulting Engineer in Westminster. Must be well educated and good draughtsman, or able of arranging lay-outs of steam, electric and other plant. Knowledge of heating and ventilating desirable, but not essential.—Address, enclosing copies (not originals) of testimonials, with particulars of qualifications and experience, and stating age and salary required, not later than Thursday, January 26th, 7231, The Engineer Office. 7231 A

CIVIL ENGINEER, Single, Not Over 30; Professional training and experience of track and construction abroad under contractors. Knowledge of French.—Write, Box No. 1948, c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 7199 A

COMPETENT and Experienced ENGINEER REQUIRED for Supervision of a Waterworks Contract in Spain, including intake from river, settling tanks, engine-house, electrically driven pumps, reservoir, filters, concrete main, &c. Must have knowledge of Spanish or French.—Address, 7229, The Engineer Office. 7229 A

ENGINEER ESTIMATOR and SALESMAN WANTED. Experienced in quotations and specifications for oil and petrol engines, marine and stationary and combined plants and lay-outs. South of England. Age, experience, and salary in confidence.—Address, 7202, The Engineer Office. 7202 A

ENGINEER REQUIRED for Estimating and Negotiating Contracts and carrying these through to completion. Public school and university man preferred. Practical training essential and some knowledge of design of centrifugal and turbine pumps desirable. Should be experienced and competent salesman with good connection, whose chief duties would be to promote energetically the sale of machinery of this character.—Apply, giving full particulars, with age and salary required, to W. R. ALLEN SONS and CO., Ltd., Queen's Engineering Works, Bedford. 7193 A

ENGINEER-REPRESENTATIVE WANTED IMMEDIATELY for India. Must be of good education and address, preferably public school or university man, having sound mechanical engineering training. One who has thorough knowledge of Hydraulics and having previous experience with large Sluice Gates, Valves and similar equipment for Hydro-electric, Irrigation and Waterworks Schemes would receive preference. Good salary and prospects for suitable man, who should be about 30 years old and preferably unmarried. Send full details of training and experience and age in first instance.—Address, 7211, The Engineer Office. 7211 A

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## SITUATIONS OPEN (continued)

GENERAL MANAGER WANTED IMMEDIATELY. Competent to take charge of engineering works specialising in gasworks plant. Must be fully qualified engineer, thoroughly conversant with modern requirements of gasworks and similar machinery. Liberal salary to first-class man.

Applicants must state (in strict confidence) age, present position, qualifications, when at liberty, and salary required; also enclose with application copies of not more than three recent testimonials.

Address, P4742, The Engineer Office. P4742 A

MALLEABLE IRONFOUNDERS (Staffordshire) REQUIRE COMMERCIAL MANAGER with expert knowledge and good connection.—Address, P4756, The Engineer Office. P4756 A

MIDLAND REPRESENTATIVE REQUIRED by well-known Engineering Journal. Must have successful record among engineering advertisers. Exclusive territory given. Excellent opportunity for smart, gentlemanly and experienced canvasser. Commission only.—Address, P4712, The Engineer Office. P4712 A

SECRETARY-DIRECTOR REQUIRED, Preferably B.Sc. with knowledge of Engineering, to control London office of provincial manufacturing company owning rapidly increasing business. Audited accounts show net profit of 56 per cent. p.a. on invested capital after payment of directors' salaries. Investment £2000; Salary £520 p.a., plus dividends. Open to solicitors' and accountants' investigation.—Write, Box 1355, Sells, 167, Fleet-street, E.C. 4. 7204 A

SMART JUNIOR ESTIMATING ENGINEER REQUIRED by London firm, with practical experience designs and sales correspondence, Steam, Gas, Electrical Plant and Centrifugal Pumps.—Address, with full particulars, age and salary, 7205, The Engineer Office. 7205 A

REQUIRED, an ENGINEER for the South of England, thoroughly conversant and capable of Designing Bakers' Ovens, to Take Charge of Small Works; excellent opening. State age, experience, in confidence.—Address, P4667, The Engineer Office. P4667 A

THE FUEL ECONOMY COMMITTEE of the FEDERATION of BRITISH INDUSTRIES has been requested to RECOMMEND a BOILER-HOUSE SUPERINTENDENT for an important brewery in the London district. Applicants must have had experience in the supervision of Lancashire Boilers and the control of firemen and be competent to make the tests necessary to ensure efficient working.

Replies, stating age, experience, and salary required, should be addressed to the Fuel Economy Department, FEDERATION of BRITISH INDUSTRIES, 39, St. James's-street, London, S.W. 1. P4761 A

WORKS MANAGER.

A small but well-established Factory near London REQUIRES a thoroughly experienced WORKS MANAGER, who has specialised on the production of apparatus of the typewriter class. He will have entire charge of the factory, but will have no responsibility for sales.

Only those experienced in the actual post-war production of this class of apparatus need apply; the position will carry a good salary and exceptional prospects for a really first-class man.

Applications, which will be treated as confidential, should state age, experience, and salary required.

Address, P4739, The Engineer Office. P4739 A

YOUNG ENGINEER, from 20 to 25 Years Old, Unmarried, preferably having public school education and some commercial training, WANTED, to join India office of well-known British Engineering Firm. Excellent prospects for right man.—Address, 7212, The Engineer Office. 7212 A

WANTED, First-class DRAUGHTSMAN, Thoroughly experienced in Colliery Screening Plant and Head Gear Construction. State experience, age, and salary required to MOUNTFORD PHILLIPS and CO. (1920), Ltd., Engineers, Llantrisant, near Cardiff. P4735 A

A FIRST-CLASS DRAUGHTSMAN WANTED for Electrical Engineering Works in London. Must have had a comprehensive experience in the design of up-to-date Switchgear and be capable of exercising initiative. A thorough works training and good electrical knowledge is essential. All applications will be treated as strictly confidential.—Address, stating age, experience, and salary required, 7061, The Engineer Office. 7061 A

DRAUGHTSMAN WANTED, First-class Man, with good experience of High-speed Steam Engines and General Engineering Work. Age 28-40 years. Thoroughly experienced men only need apply. State age, salary, references.—Apply, EASTON and JOHNSON, Ltd., Taunton. 7135 A

DRAUGHTSMAN REQUIRED for Works near London. Experience with Elevating and Conveying Machinery design essential.—Address, stating age, experience, and salary required, P4719, The Engineer Office. P4719 A

EXPERIENCED DRAUGHTSMAN WANTED; accustomed to Blast-furnaces, Steel Works, and Rolling Mill Designs.—State age, experience, and salary required to Box "N," Kidd's Advertising Agency, Middlesbrough. 7210 A

LEADING DRAUGHTSMAN REQD., Midlands. Must have thoroughly sound exp. of H.P. Steam Valve design. Excellent opening. Sal. £500 p.a.—Apply, LAURIE and CO., Employment Specialists, 29, Basinghall-street, E.C. 2. No preliminary fee. 7230 A

SENIOR DRAUGHTSMAN, Accustomed to Compressors and Air Brake work. Must be good mechanical man.—Address with full particulars, 7182, The Engineer Office. 7182 A

## SITUATIONS WANTED

ADVERTISER (35) SEEKS POSITION; Experience switches, crossings, lay-outs, steam, petrol locos., also pumps; 7 years charge D.O., 2½ charge small works; good references.—Address, P4629, The Engineer Office. P4629 B

AS General Manager, Works Manager, or Representative, ENGINEER (43), A.M.I. Mech. E. WANTS responsible POSITION; wide experience general engineering, factory control, mass production, machine shops, foundry, and commercial side; live and energetic; can tackle any reasonable proposition; first-class references.—Address, P4658, The Engineer Office. P4658 B

BUYING ENGINEER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M. 613, c/o Deacon's, Leadenhall-street, E.C. 3. 7159 B

CEMENT TECHNICIAN, Trained, Experienced home and abroad, can ACCEPT POST shortly. Abroad preferred.—Address, P4661, The Engineer Office. P4661 B

CHEMIST, B.Sc., M. Inst. Met., 29, DESIRES POST; seven years' experience metallurgical and general analytical work; some engineering training.—Address, P4731, The Engineer Office. P4731 B

ENGINEER, Having Thorough Practical Knowledge of internal combustion engines, wide experience of workshop control, selling, and administrative departments, late assistant manager abroad, DESIRES progressive POSITION in England or abroad.—Address, P4725, The Engineer Office. P4.25 B

## SITUATIONS WANTED (continued)

ENGINEER (Mechanical and Electrical), Having held prominent appointments amongst large works in Lancashire and Yorkshire during past 18 years, is DESIROUS of REPRESENTING two or more substantial FIRMS in these districts.—Write, "E. M.," c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 7148 B

ENGINEER, Mechanical (33), B.Sc., A.M.I.C.E., 18 years' experience at home and abroad, marine shop trained, drawing-office, supervision new construction, sales and general commercial experience, DESIRES POSITION of responsibility. Disciplinarian, hard worker and used to control technical correspondence in French and German.—Address, P4736, The Engineer Office. P4736 B

ENGINEER (34) REQUIRES Responsible POSITION with firm in London district. Good all-round experience. Late chief draughtsman with large concern. Highest references.—Address, P4738, The Engineer Office. P4738 B

ENGINEER (29), Patentee, Wide Experience in boilers, steam engines, turbines, pumps, Diesel, air compressors; ex-R.N. artificer; certified charge of boiler or engine-room; construction experience as fitter and turner on pile driving, hydraulic, paper and general machinery, maintenance. Progressive position preferred.—Address, P4747, The Engineer Office. P4747 B

GENTLEMAN, Well Experienced in Steel Trade, REQUIRES POSITION on administrative staff. Thorough commercial man, initiative, British and foreign experience, good organiser; accustomed to control staff, travellers, publicity, buying, selling and interviewing. Good references.—Z. Z. 528, c/o Deacon's, Leadenhall-street, London. 7187 B

HEATING ENGINEER, with Life Experience, schemes and estimates for all classes of work, supervision of installations, costing and general management.—Address, 7232, The Engineer Office. 7232 B

HIGHLY Competent BUSINESS MAN (Presently holding important post) OPEN to NEGOTIATE for POSITION with leading firm. Experienced accountant, extensive commercial training and knowledge, with practical experience in negotiating for and purchasing engineering requisites. Highest references. Interview desired.—Address, P4755, The Engineer Office. P4755 B

MECHANICAL and ELECTRICAL ENGINEER (39) DESIRES APPOINTMENT as General or Works Manager where brains, energy and initiative are of value; exceptional experience of mass production, tool design, estimating, costs, &c., and control of large staffs.—Box 435, Halston, High-road, Goodmayes. P4724 B

MECHANICAL ENGINEER, Age 23, DESIRES APPOINTMENT, any capacity, with view to specialising; workshop and drawing-office experience. Low salary required.—MORGAN, 49, York-road, Hitchin. P4657 B

MECH. ENGINEER, Age 24, DESIRES ENGAGEMENT; 9 years' shop practice, D.O., sales and progress in aircraft and motor production.—Address, P4721, The Engineer Office. P4721 B

MECHANICAL ENGINEER, Experience as Manager, foreman and all other grades, REQUIRES responsible POSITION, any capacity; energetic, first-class references, running repairs, steam, gas, oil, marine; moderate salary.—Address, P4746, The Engineer Office. P4746 B

MECHANICAL ENGINEER, with Good All-round general experience as foreman, cost clerk and manager, SEEKS responsible POST in any capacity, any district.—SNOAD, 36, York-road, Hitchin. P4753 B

TECHNICAL AND CLERICAL ASSISTANT.—POST DESIRED by young man with some engineering training and good practical and theoretical knowledge of mechanics, mathematics, electricity, chemistry, and general physics.—S. E. H., 173, Cronin-road, Peckham, S.E. P4741 B

TO DIRECTORS.—GENTLEMAN (40), M.I. Mech. E., with wide and varied experience in works management, production and general management, DESIRES highly responsible and progressive POST. Capable of relieving a board of directors from many worries and getting satisfactory results. Has successfully controlled work employing 5000 hands and really obtained economic production. Thoroughly versed in sales organisation, estimating and all departments necessary for successful business. For last three years assistant general manager of a large and well-known firm. Credentials furnished of the highest character. —Address, P4683, The Engineer Office. P4683 B

TURKEY.—ENGINEER, A.M.I.M.E. (29), with sound commercial experience and public school education, SEEKS COMMERCIAL POSITION with agency in Turkey; specialised oil-gas engines and producers, pumps, rolling stock; speaks Arabic fluently.—Address, P4744, The Engineer Office. P4744 B

YOUNG ENGINEER (28), Designer of Capstan and Combination Machines, SEEKS POSITION, any capacity. Address, P4750, The Engineer Office. P4750 B

YOUNG ENGINEER WANTS POSITION; Well educated, competent in general work, expert welder, good draughtsman.—E., 70, Holmwood-gardens, Brixton Hill, S.W. P4711 B

AS CHEMICAL ENGINEERING DRAUGHTSMAN (25), experience in works planning, lay-out and details of special chemical plant, including carbolic distillation, salicylic, and saccharin, structural steel work design, reinforced concrete, &c.—Address, 7217, The Engineer Office. 7217 B

DRAUGHTSMAN (34), Heating, Ventilating Fans, dust extracting, shops experience, DESIRES BERTH.—Address, P4748, The Engineer Office. P4748 B

DRAUGHTSMAN, Junior, Age 17, REQUIRES POSITION in an engineer's office. Had experience in both office and works.—Write, "J. P.," 25, Ansdell-road, Peckham, S.E. P4732 B

DRAUGHTSMAN (Mech.), 24, Good Detailer, 8 Yrs. D.O., 2 yrs. commercial, REQUIRES POST; London preferred. Routine work would be accepted.—DUNKLEY, 62, Rylett-crescent, London, W. 12. P4756 B

DRAUGHTSMAN SEEKS POSITION in London; good all-round general experience (office and works), also good surveyor and leveller.—Address, P4749, The Engineer Office. P4749 B

ENGINEER'S LADY TRACER and DRAUGHTSMAN; 3 years' experience; excellent refs.—Address, P4718, The Engineer Office. P4718 B

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For continuation of Small Advertisements see page iii

# Iron, Steel, Coal and Engineering Trades in 1921.

No. III.*

## SCOTLAND.

An interesting event at the very beginning of the year was the decision of the Glasgow Corporation to purchase a couple of brick works at Dalry, Ayrshire, in order to expedite the Corporation housing schemes and to cheapen the cost of materials. Trade prospects generally in the West of Scotland were not so black in January as some people tried to paint them, though there was nothing to boast about, and new business was coming forward very slowly. With what looked like remarkably intelligent anticipation of events, the Highland Railway Company provided in that month the first practical demonstration in Scotland of the substitution of oil for coal fuel for locomotive engines; but perhaps the real explanation of the innovation was that the company had to bring its locomotive coal from a distance of 300 miles! Before the close of the month a rather notable launch took place, the Forth Shipbuilding and Engineering Company, of Alloa, putting into the water the steamer Madœra, of 13,300 tons deadweight. The vessel, for Dutch owners, was the largest then built on the East Coast of Scotland, being 480ft. long, 60ft. in breadth and 40ft. in moulded depth. In all, nine vessels were launched on the Clyde during January, of an aggregate tonnage of 23,585; but with the advent of February the situation was far from encouraging, there being an almost entire lack of fresh contracts, while the iron and steel trades were experiencing a period of acute depression. Early in February the oil drilling operations at West Calder were resumed after a stoppage of several months, but about that time labour troubles were threatening in the shale oil industry. While many collieries were, in this month, working short time, extensions were being carried out in the Carluke district of Lanarkshire, sinking operations being undertaken with a view to reaching other seams than those then worked; and another matter of interest was that negotiations were proceeding between the town authorities at Grangemouth and a well-known oil company for the erection of an oil refinery on a large scale at the port.

### A Matter of Serious Concern.

The February shipbuilding returns for the Clyde area looked far more prosperous than the situation actually was at the opening of March. No fewer than twenty-five vessels of 82,431 tons were launched, but the fact had to be remembered that as contracts were worked off no new ones were forthcoming; moreover, owing to the joiners' strike, many of the vessels launched were not getting much nearer completion. Nevertheless, some people saw signs of improvement in the tendency for costs of production to decrease, though the slump in freights was no encouragement to shipowners to build. From the Fairfield yard an oil tanker was put into the water in March, the statement being made on that occasion that although there were then about 800 oil tank steamers afloat, two or three times that number would be required to carry the oil available in various parts of the world.

The March launches on the Clyde exceeded in number even those for February, thirty vessels of an aggregate tonnage of 56,410 leaving the stocks, making, for the three months, sixty-two vessels of 149,841 tons, compared with thirty-three vessels of 97,954 tons in the same period of the previous year; but there was no disguising the truth that the shipbuilding situation was becoming a matter of very serious concern, the iron and steel industries were suffering severely from depression, and the Scottish coal trade was almost at a standstill.

Mention must be made, in passing, of the fact that at a special meeting in March of the Glasgow University Lord Weir intimated a gift of £30,000 from the Institution of Engineers and Shipbuilders in Scotland from the memorial fund subscribed in commemoration of the centenary of the death of James Watt, for establishing in the University Department of Engineering two James Watt Chairs in the subjects of heat engines and electrical engineering.

### Trade Strangled.

A pleasant interlude in April was the commemoration by David Colville and Sons, the Motherwell firm of engineers, of the jubilee of the business; but that was the month that plunged the country into the national coal strike, and the Scottish iron trade was strangled, the blast-furnaces all being out of action, and stocks of pig iron in makers' yards being hardly tapped at all. Smelting was discontinued, and both buyers and sellers were merely marking time. In this month, too, came the inevitable slowing down of output from the shipyards, the April returns showing that twenty-one vessels of 22,836 tons were launched compared with nineteen of 85,008 tons in the corresponding month of 1920. By the middle of May industry throughout the Clyde Valley was in a state of suspension. The steel works and galvanised iron departments were inactive, and although foreign inquiries were said to be better the impossibility of naming deliveries gave little hope of carrying matters beyond the inquiry stage. During this month negotiations were proceeding for the sale of the Blythswood Shipbuilding Company, Limited, at Scotstoun, to interests which made an offer to purchase the £1 ordinary shares at the price of 50 per cent. above the amount subscribed and paid up. Within a few weeks of the termination of the coal strike a hopeful feeling developed in West of Scotland industrial circles, there then apparently being good reason for anticipating an early recovery in the steel trade, but these hopes, as events proved, were considerably deferred, for new business continued to be as hard as ever to secure. The loss in wages to Lanarkshire steel workers alone, through the coal strike, was estimated at about £3,000,000.

The month of August was associated with the development of very serious depression in the Clyde shipyards, but an effort was being made to restart production of pig iron, though demand was light, but for finished iron and steel fair inquiries were coming forward, and tube makers had moderately good home and export orders in hand. With the end of the joiners' strike hopes were revived that shipbuilding might experience better times, and although a month later more activity was recorded it was due to an attempt to overtake arrears caused through the joiners' strike rather than to any actual increase in business. In fact, new contracts were exceptionally scarce, local quotations not holding out much inducement to shipowners. Wages certainly had dropped a trifle, but other oncosts remained very high.

### Vessels Lying Idle.

The motor ship seemed to be increasing in popularity, several being on hand on the Clyde, while works constructing marine internal combustion engines had a large number of orders for Diesel engines. The shipbuilding returns for August showed that thirty-four vessels of 34,616 tons were put into the water, which compared with thirteen of 29,448 in July, sixteen of 40,371—one steamer accounting for about one-third of the total—in June, and nineteen of 22,752 in May. By mid-September hope in the shipyards was once more reviving, in view of the possibility of the receipt of Admiralty orders, though, so far as the mercantile side of the question was concerned, prospects were very poor. Idle ships, empty wharves and unemployed seamen indicated an unparalleled state of affairs. On the Clyde over 40 vessels were out of commission, and upwards of 700 navigating officers were unemployed. One company was said to have had every one of its boats laid up. The Lanarkshire steel works were in a bad way. Wholesale suspensions were reported among employees of the Steel Company of Scotland, while the Lanarkshire Steel and Ironworks were closed down indefinitely and some of the collieries stopped altogether. Before the close of the month, however, a Kirkcaldy firm—Douglas and Grant—against strong German competition, was reported to have secured a contract for machinery to the value of £70,000 for Rangoon. So far as iron and steel were concerned, though inquiries were quite numerous, indicating the possibility of fresh business, actual contracts were as scarce as ever; but the September shipbuilding returns benefited from the fact that the joiners had returned to work, the Clyde output of sixteen vessels, aggregating 50,152 tons, being the third highest of the year. The apparent improvement, however, was no indication of a trade revival, for the outlook did not at that time warrant the construction of new boats. Shipyards, nevertheless, made heavy sacrifices in order to keep as many men as possible employed, a fact to which pointed reference was made by Sir Alexander M. Kennedy, managing director of the Fairfield Shipbuilding and Engineering Company, Limited, on the occasion of the launch of the Anchor liner Tuscania from that company's yard. Then came the orders for the battle-cruisers, and the subsequent disappointment, but the Motherwell Bridge Company secured a contract for the erection of steel work abroad on behalf of the Admiralty, the business, which will provide work for a considerable period, being won in face of keen competition. This was in November, when engineering shops generally were on short time and steel and iron tube mills were similarly placed, while it was very doubtful if a fair amount of business secured by malleable iron makers was of more than a transitory character. Early in December a rather better request was reported for structural steel, and a fair turnover was being done in machine tools, and consumers in the Far East appeared to be better buyers.

### Some Interesting Reports.

Just as the year was drawing to a close the Blythswood Shipbuilding Company, of Scotstoun, put its first ship into the water, the Jackson, an oil tanker of over 10,500 tons deadweight, into the design of which several novel features were introduced. As matters now stand, there are practically no new orders for the Clyde, one of the reasons, perhaps, being revealed by the fact that Australian builders can construct vessels at £2000 per ship less than the British price and still pay higher wages than are paid here. On the other hand, according to rumour, inquiries which bore every appearance of being likely to materialise into actual business were in the market for upward of a dozen steamers for foreign interests.

In the course of the year a number of very interesting trade reports emanated from the Iron and Steel Exchange in London. One of these, in May, was to the effect that an important Scottish concern had booked orders for 120 large locomotives for English railways and that most locomotive builders could run double shifts were fuel and steam available. Another asserted that the contract secured by the Motherwell Bridge Building Company from the Admiralty was for ten oil fuel tanks to be erected at Rangoon, each tank being of 120,000 tons capacity. One other fact that might be mentioned was the temporary closing down, in November, of Yarrow and Co.'s works, with the exception of the firm's experimental and research departments. This step was taken in consequence of "repeated strikes, reduction of output and demarcation disputes," but the directors expressed great faith in the future of the shipbuilding and engineering industries, and the belief that prosperity would return "when everyone realises that commercial undertakings can only be carried on with success in accordance with economic laws."

## SOUTH WALES.

Bad as things were in Wales and the adjoining counties when 1921 opened, the fear at that time was that the worst had not been seen—a fear that unfortunately was only too well justified. Coal exports were going to pieces, for the price of Welsh fuel was so high that competition with American supplies was almost impossible. At the same time, the situation in the iron, steel and tin-plate industries was extremely serious, while patent fuel works in South Wales were only operating intermittently. The gravity of the situation was not generally realised. Comparatively few of the steamers in Welsh ports were actually loading, and it was estimated early in January that at least 100 were laid up waiting for freights to improve. About the middle of the month, however, the District Coal and Coke Supplies Committee announced that the whole balance of output from South Wales collieries would be free for export after the requirements of inland consumers had been met, but even this seemed to bring no real improvement in its train. The visit of Messrs. S. Callaghan, D. R. Llewellyn and H. Seymour Berry to France in February led to the renewal of part of their contracts which were cancelled owing to the strike at the Gwaun-cae-Gurwen collieries, with the result that one of the pits was re-opened, and at Llanelly the industrial position was improved a little by the re-starting by Richard Thomas and Co. of sixteen tin-plate mills, though the improvement was only temporary. To some extent, however, the gloom was lightened by the preparations of the Powell Duffryn interests to erect extensive engineering works and wagon sheds in connection with the Penallta colliery, the Rhymney Railway Company providing an additional junction for transport purposes and arrangements being made to supply current to the new works from the Powell Duffryn Company's own electric power scheme. On the other hand, the prospects at Ebbw Vale were very gloomy. Everything was at a standstill at the great iron and steel works, except for one order at the latter, while the by-product plant and the furnaces at Victoria, including the million pound furnace, was idle.

### Breaking the Patent Fuel Ring.

In March the patent fuel ring was broken, makers beginning to quote their own prices and to compete keenly for whatever orders were available. Meanwhile, operations on the coal market were at a very low ebb, but it was reported that, in view of the Australian miners' strike, the New Zealand Government had arranged for 150,000 tons of Cardiff and Monmouthshire steams for the New Zealand railways, and the Electrical Light Company, of Monte Video, was in the market for 50,000 tons of large steams. The coal strike, precipitated in April, proved disastrous in the extreme, and long before the settlement was reached the bulk of the tin-plate works were at a standstill. In the meantime the well-known South Wales coalowners, Messrs. D. R. Llewellyn and H. Seymour Berry, had acquired the Rock Colliery, Glynneath, with the intention of developing the mine, which had been idle from a date long before the strike. In June, owing to trade depression, the trustees of the Swansea Harbour Trust intimated their intention of closing the North Dock, but, on the other hand, Swansea was selected as the site of new works for dealing with phosphate rock imported from the island of Nauru, and early the following month the Port Talbot Steel Works furnaces were re-lighted, hopes being then entertained that operations would almost immediately be resumed in the mills and other departments. About the same time three Siemens steel furnaces at Baldwin's Swansea works were re-lighted, and it was reported that Guest, Keen had secured a contract for 13,500 tons of steel rails for India, though according to another rumour current at that date it was the Dorman firm that had booked the business. The Powell Duffryn concern in July commenced sinking twin pits near Bargoed, in the Rhymney Valley, but the bulk of the tin-plate works in South Wales were still idle, partly as the result of the dearth of orders

* No. II. appeared January 13th.

and partly owing to the high price of coal. The Llanelly mills of Richard Thomas and Co. made a fresh start at the beginning of August, and about the same time it was reported that a contract for the Argentine railways had been settled for 10,000 tons a month for four months of Monmouthshire black vein at 35s. for large and 20s. for smalls. Two new pit shafts were then being sunk in the Treherbert district of the Upper Rhondda, and it was stated that the French railways were in the market for 20,000 tons of Admiralty and leading Monmouthshire large coals at an approximate price of 38s. 6d. c.i.f.

**Works Restarting.**

Toward the close of the month, Baldwins booked an order for 17,000 tons of rails, and it was announced that preparations were being made for re-starting the iron and steel plant at the Ebbw Vale works, while about a month later one of the largest consignments of tin-plates and galvanised sheets was cleared from Swansea for Shanghai, Singapore, Yokohama and other ports in China and Japan and the Straits Settlements. It was stated in October that the French naval authorities had purchased supplies of Welsh coal on a c.i.f. basis for delivery over the remainder of the year, the weight being between 50,000 and 60,000 tons of Admiralty large, and through French interests the French Marine, it was understood, bought 100,000 tons of smalls from South Wales. In the same month the Eagle Tin-plate Works, Neath, were acquired by Baldwins, the figure mentioned being about £30,000. It was about then that the Cardiff Railway Company was erecting new outer lock gates at the entrance to the East Basin leading to the East Dock. The two gates weighed 75 tons, and the old ones had been in use sixty-two years. Works continued to resume operations, though in most instances only partially, but owing to the high costs some further good ship-repairing business was lost to South Wales. One of the most interesting acquisitions of the year was that which gave to the Guest, Keen people control over the Gwaun-cae-Gurwen collieries. Important tenders for coal for India, Japan, Brazil and Norway were then under consideration, and the British Admiralty was in the market for about 250,000 tons. Negotiations were in hand for amalgamating the interests of the Mountstuart Dry Docks, Limited, with those of Mordey, Carney and Co., Limited, of Newport, John Shearman and Co. (Newport), Limited, and John Shearman and Co., Limited, Cardiff. The visit of Hugo Stinnes, the German iron and coal magnate, to this country in November revived rumours of his intended renewal of activities in the Welsh coalfields, but while nothing more was heard of the matter, there were stories in circulation that before very long one of the largest German coaling firms would be opening at Cardiff. At the end of the month the tin-plate outlook was considered to be rather brighter, and Richard Thomas and Co. were said to have booked 150,000 boxes for British Columbia. In the last month of the year further huge inquiries were being made on behalf of the Indian Government and the railways for Admiralty, Cardiff and Monmouthshire large coal.

## THE FUEL POSITION.

Reverting to the situation at the collieries, it may be recorded of the past year that it was a particularly interesting one. Up to the end of March the whole industry was Government controlled both for disposals and finance. At the beginning of 1921 trade generally had not recovered from the two and a-half weeks' strike that occurred in the previous October-November. Inland industrial consumption had fallen off very substantially, affording every opportunity for manufacturing concerns to build up reserve stocks against the possibility of labour trouble at the pits. In fact, in view of the rather ominous outlook large stocks were accumulated, but this foresight on the part of manufacturers was largely neutralised by the order issued at the commencement of the national coal strike in April reducing consumption at industrial concerns to 50 per cent. of the average for the four previous weeks. Of course, when the strike began few people had any idea that it could continue for thirteen weeks, and, taking all things into consideration, it was really nothing short of marvellous how the country "carried on." Many works continued operations on a limited scale up to the end of May, but were then compelled to close down. Outcrop coal, "got" by the men on strike, together with coal imported from the United States and other countries, was of great assistance in helping through the period of the stoppage.

During February and March the demand for small fuels was exceptionally slow; indeed, so heavy were stocks under load at pits that in many cases short time had to be worked entirely on this account. Midland collieries had orders on hand for large steam coal and cobbles, but small fuels were a glut on the market. This condition, however, was really a blessing in disguise, as when the stoppage commenced collieries had large supplies of small fuels for use at boilers and coke ovens, and although in many cases coke ovens were closed down by the middle of May, most collieries had no difficulty in keeping up steam for pumping operations. When work in the pits was resumed on July 5th, there was a very large demand for all classes of fuel for manufacturing purposes, and most collieries took full advantage of the market conditions by obtaining the best possible prices. No doubt many manufacturers were far too anxious to secure supplies, and as a result contracts were entered into to the end of the year at top prices. This was unfortunate, in view of the slump that occurred early in September when prices began to break, since when, up to the end of the year, more or less weakness was in evidence. There was a considerable amount of comment in North Midland circles by reason of the fact that since September prices of steam coal sold for export were appreciably lower than for open market quotations for inland sales. With the severe competition for business values steadily settled down, although by virtue of the conditions prices as between contract and open market rates showed a very wide difference, in some cases as much as 10s. per ton, and there was also an appreciable margin between open market prices for the same qualities. What greatly upset the inland market during the last quarter were the special lots offered from stocks at low rates. Buyers of large quantities obtained some good bargains, perhaps more particularly of small fuels.

**Highest F.O.B. Price.**

Exports from the Midland areas were not so heavy as usual in the last half of the year, on account of the severe competition from Tyneside collieries. Nevertheless it is satisfactory to note that after losing so many of our oversea markets to other coal-producing countries during the period of the acute scarcity, as a result of the price reductions effected these markets are being recovered. It will, perhaps, be remembered that the highest average f.o.b. price recorded for exports for the whole country was in September, 1920, of 89s. 9d. By December of that year the figure had fallen to 81s. 2d. The following are the approximate tonnages and average f.o.b. prices for exports to the nearest penny for the year :—

| | Million tons. | F.o.b. price. s. | d. |
|---|---|---|---|
| January | 1.7 | 65 | 4 |
| February | 1.7 | 49 | 1 |
| March | 2.0 | 43 | 6 |
| April | .6 | 43 | 2 |
| May | .014 | 46 | 9 |
| June | .007 | 33 | 10 |
| July | .82 | 38 | 3 |
| August | 3.1 | 36 | 6 |
| September | 3.4 | 30 | 6 |
| October | 3.4 | 28 | 6 |
| November | 3.6 | 27 | 2 |

The reduction in the average f.o.b. price for exports as between January and November was, therefore, 38s. 2d. per ton, or, as compared with the highest price recorded—September, 1920—62s. 7d. per ton.

In the Midland area wages are still about 109 per cent. above the 1914 base, but as a matter of fact, the actual percentage is considerably greater by reason of the fact that certain advances are not included in making the comparison. No further substantial price reductions can be made until wages are again reduced, and in this direction it seems regrettable that the miners and their leaders do not appear to realise the great advantage that would accrue by reverting to eight-hour shifts. If that were done there would be an immediate reduction in the price of coal—a movement that would be reflected in the cost of the manufacture of every article in which fuel is used. There is little doubt that, sooner or later, as a result of international competition, eight-hour shifts will have to be reverted to if we intend holding our place as a commercial nation.

**Railway Rates.**

After the announcement regarding a reduction in railway charges, as from the 1st inst., was made, there was a considerable suspension of deliveries in manufacturing fuels in order to secure the advantage. The reduction, however, of only 25 per cent. of the 100 per cent. increase, up to a maximum increase of 4s. per ton, is much less than had been expected. Of the bulk of fuel that comes into Sheffield, for example, the saving effected will be from 5d. to 8d. per ton, according to distance. This is, of course, in the right direction, but such a reduction cannot go very far in the way of helping the iron and steel industries to get into full swing again. Considering there will be very shortly a further reduction in the wages of railway workers, together with the fact that as from the 1st inst. railway concerns will obtain steam coal at reductions of somewhere about 8s. per ton, as compared with contract prices in operation to the end of the year, it looks as though the least possible reduction was made in rates, and particularly so as the maximum increase of 4s. per ton is unchanged. Other references to the coal position, it will have been noticed, have been made under the separate district heads.

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THE Dublin and South-Eastern Railway is a more progressive railway than most people imagine, all its compartments, for instance, except those labelled "non-smoking" are available for smoking. It has now abolished second-class except for the stations between Dublin and Greystones and substantially reduced the first-class fares. Return tickets have been discontinued.

# Friction Lifters for Drop Stamps.

By W. H. SNOW, Wh. Ex.

No. II.*

### BOARD DROP STAMPS.

THE characteristic feature of most board drop stamps—see Fig. 9—is the automatic action produced by a mechanism of a primitive order that, like the picking mechanism of the weaving loom, seems continually to invite improvement, but which for simplicity and severe practical qualities continues to hold its own. It is only intended here, however, to treat in general terms of the design of the lifting gear which for this purpose falls into the class of Figs. 6, &c. The angle of lap is zero, the pressure roller occupying what in Fig. 6 is the position of initial contact of band and drum. Compensating for the absence of coiling effect, the pressure roller is revolved and constitutes a duplicate drum, the board being gripped on both sides. The squeeze needed is the same as for a coiled belt and idle roller at an angle of 120 deg., for $\mu = .33$.

The preceding remark on the design of belt stamps applies equally to board drops—the product of roller diameter and board width should be proportional to weight of tup. This fact leads to a low speed of rotation in large sizes and a clumsy drive. The stamp is unsuited for carrying gearing to enable a high belt speed to be used, and this restricts the possibility of adhering to any rule based on constant pressure, with the result that the rollers get proportionately smaller with increase of size of stamp, until at about 3000 lb. the board will not stand the crushing.

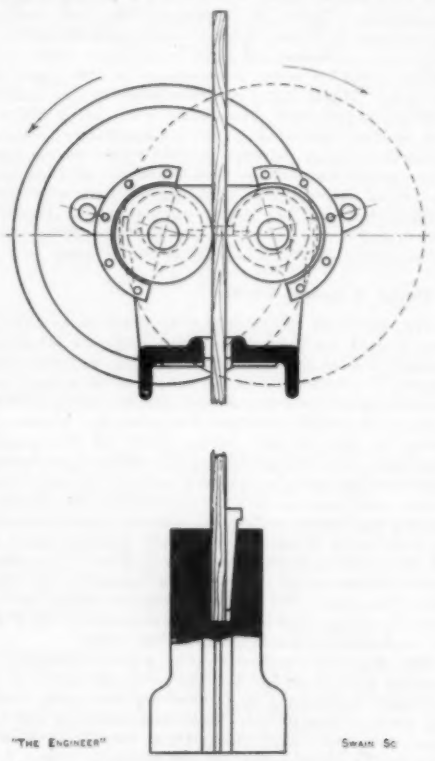



FIG. 9

Roller diameter appears in practice to vary as $W^{\frac{1}{2}}$ or slightly less, and the board width as $W^{\frac{1}{2}}$. These proportions give in a 3000 lb. stamp a unit pressure on the board 1¾ times that in a 300 lb. size—not a very extreme variation, but the board drop device is of a fortuitous character, and it starts in small sizes with no very adequate margin for wear of board, and its usefulness is thus limited.

As the tup cannot be held suspended in the grip of the rollers, owing to the rapid destruction that would result, the board drop lacks the control necessary in an increasing degree with increase of size, and its usefulness, if for this reason alone, is bound up with small sizes, where the work allows of a regular automatic action intermitted only with definite pauses between the heats when the tup can be caught up and held either positively or by friction grips applied to the board near the rollers. Some control of the force of the blows can be attempted by bringing the grips into play as the tup falls, but generally the stamps are worked with uniform blows.

### CLUTCH-OPERATED LIFTERS.

In all the lifting devices described so far the speed of the friction surface is the same as the steady lifting speed of the tup, resulting, as we have seen, in low speeds of rotation when the diameter of drum is increased and bad proportions in the larger sizes, and in practically imposing a limit on the size attainable. To get over these defects an independent clutch must be employed, which it is possible to proportion without being hampered by considerations

* No. I. appeared January 13th.

of the lifting speed, *i.e.*, the friction surface must be one the speed of which can be arranged in any ratio to the speed of the tup. This is quite apart from the equally important matter of the employment of a proper fricton material, the lifting belt being kept to its own proper function. A successful arrangement is shown in Figs. 10 and 11. The tup is lifted by a belt wound round a loose pulley A, the belt being attached to an arm B. This arm is loose on the shaft and carries a clutch band C lined with woven friction material, encircling the drum D, which is fixed to the shaft and revolves with it; and the band is caused to grip the drum by the actuation of a lever E and excentric F through the pulling cord G, the arm turning through about five-sixths of a revolution. The stroke being 7ft., the loose pulley is about 30in. diameter, and for a lifting speed of 480ft. per minute, the drum turns at 60 revolutions per minute. This peed of rotation may hold for all sizes, because

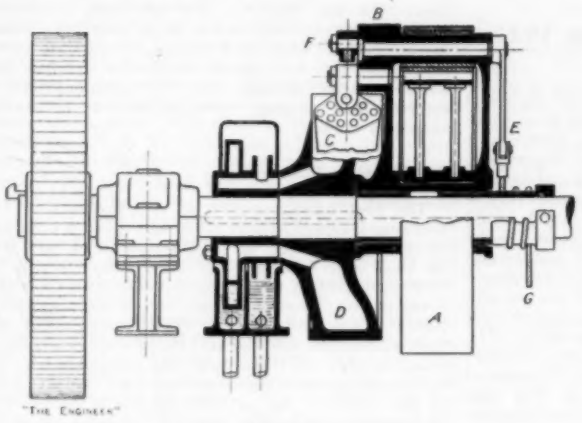



FIG. 10

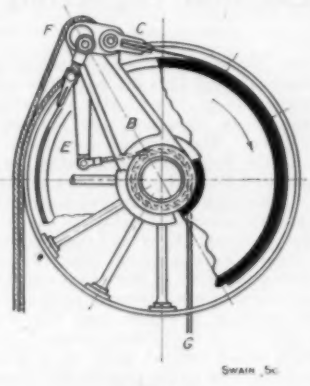



FIG. 11

change of drum diameter can be effected without regard to the loose pulley diameter and lifting speed, and the problem of driving remains a simple one. The drum speed is therefore proportional to its diameter for a given lifting speed, and whilst in former cases $W = b\,D \times$ constant, in the present case $W = b\,D^2$ (constant). Making $b$ proportional to D, the capacities vary respectively as $D^2$ and $D^3$. A doubling of the diameter in the one case would, if other considerations allowed, give an increase of capacity of four times, whilst in the other eight times is obtained and without any inconvenience. The rule for constant pressure on the friction material can thus be easily adhered to, and large lifters are as reliable and smooth in action and give as good a performance as small ones.

If D and $d$ be the diameters of drum and pulley respectively, and W the weight of falling parts, the net pull $T_1 - T_2$ in the friction band is $\frac{d}{D}$ W. With $\mu = .3$, the ratio of tensions $\frac{T_1}{T_2} = 5$ and the maximum pull $T_1$ in band $= \frac{5}{4}\frac{d}{D}$ W. Let $p$ be the allowable pressure on the lining of the band, and $b$ the breadth, then $\frac{T_1}{\frac{D}{2}} = p\,b$, $T_1 = 2\,D\,p\,b = \frac{5}{4}\frac{d}{D}$ W, and W $= \frac{8}{5}\frac{D^2}{d}p\,b = K\,D^2$. As already stated, when $b$ is proportional to D. $p$ ranges from 50 lb. per square inch in lifters of 5 cwt. size to 75 lb. for a 4-ton size, and the figures cover dies weighing from 25 to 40 per cent. of the tup weights. They give the maximum pressure at the $T_1$ end of the band. It is usual now to make the band taper in width, resulting in fairly uniform pressure throughout, giving equal wear, and saving material. In stamps above 40 cwt. or 50 cwt. size twin drums are employed, one on each side of the loose pulley, a 60 cwt. stamp having two drums of 30 cwt. size, and so on.

Disregard of the correct principles of design in lifters with separate clutches led to much trouble and dissatisfaction with some of the early makes. The drums were practically of constant diameter—about 24in.—and varied in width only, from 5in. or 6in. in a 10 cwt. stamp to 10in. in one of 50 cwt. capacity. In order to get the necessary tension in the band in large sizes the excentric was of small radius, and the band had to be closely adjusted. Rapid wear took place and frequent adjustment was necessary except under the easiest conditions, and the bands being over-strained and also faulty in detail, often gave trouble. It may be remarked that whereas with fluid pressure apparatus insufficient attention to the rules for proportions may result in a fiasco, the machine refusing to work at all, a poorly designed friction device can be got off the makers' hands and left to take its chance. Under easy conditions it may answer its purpose; contrariwise, spare parts will be in frequent demand. Pounds per square inch on friction material do not always get the respectful attention of necessity accorded to steam or air pressure.

Lifters with separate clutches generally lend themselves to an arrangement of actuation embodying a hunting movement, and can be easily controlled, all that is necessary being to pass the pulling cord connected to the setting up mechanism of the clutch round the shaft, so that it winds and unwinds with the to-and-fro movement of the clutch arm. It is, of course, essential that the clutch be self-releasing, needing only to be put into engagement, the release being effected automatically by a spring. The amount of release should be proportional to the diameter of drum, so that the band frees itself to an equal degree in all sizes, and this requires an excentric radius varying with D. Otherwise, the "spring" in the band with large drums absorbs too much of the release movement, and reduces the clearance, causing the band to drag when the tup falls. As the length of the lever can only vary with the drum diameter, the pull for actuating varies as $W\frac{3}{4}$. This pull in the earlier lifters, where the cord was taken round a loose sheave or the shaft, had to be exerted direct by the operator, and a strong pull was needed in large sizes. The author's remedy was to introduce the principle of a small "relay" clutch to operate the mechanism of the main clutch, the relay being proportional to work always with the same actuating force—*vide* "Trans.," Manchester Association of Engineers, 1916–17, page 194. All that was necessary in the case of the stamp lifter was to fix the sheave to the shaft and wind the cord round it two or three times. The revolving sheave then acted as a capstan, the light band pull being multiplied owing to the coiling to the extent required. The device of a relay, extremely simple in this particular application, enables any stamp, however large, to be operated with the same ease as the smallest. This point has been referred to in some detail, as it is believed that the principle would, if applied to large clutches for ordinary transmission purposes, get over various difficulties that are now regarded as unavoidable, such as excessive operating force, insufficient clearance, and the need for frequent adjustment if the clutch is often put in and out of action.

The lifter described is generally arranged to be water cooled. It will be obvious that whenever the tup is held suspended by friction, the same work that is done in lifting goes into heat, the apparatus for the time being constituting a dynamometer. The easier the lifter is to control, the more frequently will advantage be taken of the possibility of holding up by power, and hence the provision for cooling in this type. The arrangement illustrated was introduced from Belgium. The two compartments of the distribution box are separately connected to a tank. The reduction of level caused by water being picked up by the revolving coil in one compartment, and the rise of level in the other, due to the return after passing through the drum, gives the "head," in virtue of which the water circulates. For long pipes, however, this head is insufficient, and a small pump is used, providing a positive circulation. In double drum lifters the water is pumped through the shaft. The details of the cooling system require to be properly worked out if trouble with joints, due to vibration, is to be avoided.

Heating must, of course, occur apart from holding up to an amount depending on the acceleration. The work lost, shown by the efficiency curves of Diagram 3 (*ante*), appears as heat. It is smaller with clutch lifters than with kick stamps, due to the higher acceleration in the former. The efficiency and speed characteristics depend on the type of lifter employed only in so far as one type may be more powerful than another, giving higher acceleration; and Diagrams 2 and 3 (*ante*) are of general application.

Fig. 12 shows an arrangement of clutch lifter in which, as made, increase of capacity is obtained by additions to width only, a single gripping block being used for a small lifter, two for the next size and so on, each block, in its own groove, representing so many hundredweights lifted. About 6 cwt. of tup weight per block appears to be an average figure. The diameter of the drum has to be approximately that of the loose pulley for the arrangement shown. The grooves may have an included angle ($2\theta$) of 40 deg. Lubrication being essential where the contact is metal to metal, iron or steel drums and bronze blocks being used, $\mu$ may be taken at not more than 0.1, and the normal load on the surfaces per block to lift 6 cwt. plus, say, 1½ cwt. dia., is 4200 lb. The pressure per square inch, taking 8in. as the length and 2¼in. side of groove, is approximately 200 lb. The radial force $[F = 2\,P\ (\sin\theta + \mu\cos\theta)] = 3680$ lb. These figures may be contrasted with those obtaining for the band type of clutch, where the greater part of the circumference of the drum is in use instead of only a small portion. In the event of failure of the lubrication, the blocks wear rapidly. The load is localised, and the drum requires to be made very strong. In a 30 cwt. lifter the concentrated load is 8 tons.

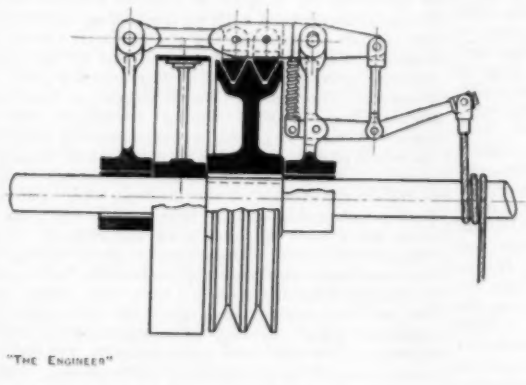



FIG. 12

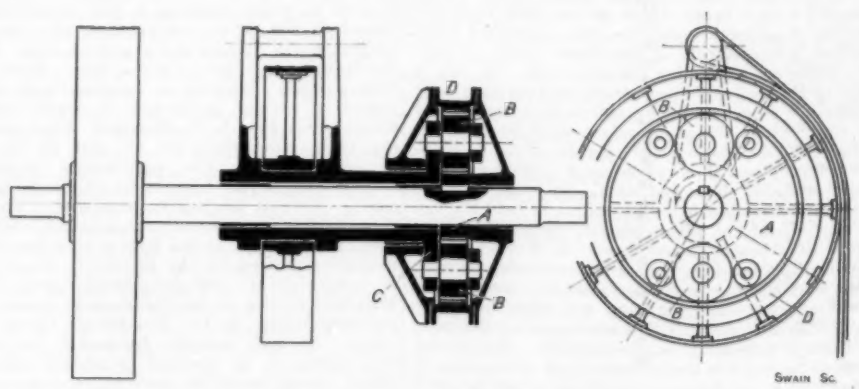



FIG. 13

A lifter clutch requires to be operated with the minimum of effort. Its driven part should be light in weight to reduce inertia losses during the fall. A clutch working with lubricated surfaces involves large forces in its operation, and these forces in turn demand strength in the parts and entail weight. Hence, such a clutch is not the most suitable for a stamp, apart from whether or not the lubrication of external surfaces in a hot and none too clean atmosphere is a reasonable thing to demand. Lubrication cannot, of course, take the place of water cooling, except at the expense of the lubricant. For a given amount of slipping, the same heat will be generated whatever the type of clutch, and evaporation of the oil will take place in a lubricated clutch in the process of dissipation.

A third example of separate clutch is shown in Fig. 13. This is an application of an epicyclic gear

with brake used in connection with single-phase electric motors for starting purposes. The shaft and central pinion A revolve continuously at a high speed. Normally, the rotation of the idler wheels B on arm C, gearing with A and with internal teeth in the drum D, causes the latter to revolve, but by means of a brake band encircling D, the latter can be held, and then the idler wheels B move round inside the drum and the arm C rotates. The latter is in one with the lifter arm F, which in rotating raises the tup, as in previous arrangements.

This arrangement is very compact, but compared with Fig. 10 the inertia is considerable. In Fig. 10 the brake band has to be carried round with the arm, but in Fig. 13 the arm C, wheels B and drum have to be dragged round when the tup falls. The inertia effects have to be considered separately as the speeds in the two cases are not alike. The band and arm turn alike, the speed of rotation being, at a maximum, just before the blow is struck, 150 revolutions per minute for a fall of 6ft.; but the drum and wheels turn considerably faster, the former at perhaps 275 revolutions per minute, and the latter at 400 for 150 revolutions per minute of arm, and at these high speeds the inertia, varying as the square of the speed, will be considerable, and the fall of the tup will be retarded, reducing the force of blow and speed of working.

The extreme simplicity and low first cost of the kick stamp hindered for a long time the adoption of more highly evolved lifters, and various attempts have been made to get a clutch action and easy operation with fewer parts than a proper design necessitates. Usually in these the belt is wound up on the friction drum, so eliminating the winding pulley. One example resembles Fig. 12. The drum is made plain, a pad of friction material is fitted in place of the vee blocks, and the lifting belt is attached in line. What happens is that as the belt winds on to the drum, the friction between the two gives an added lifting effect, and the effort for operation continually decreases. The final result is that if the lifter be designed to work with a small effort, as by using a relay clutch of some sort, there is a possibility that the residual friction in the relay may be sufficient alone, after a certain degree of coiling has been reached, to sustain the load, and the clutch then "takes charge" and overwinds. Clutches of this kind do not, of course, fulfil the requirements of correct design.

A point that should be sufficiently clear on a little study, but which is generally overlooked, is that the load on a loose pulley—Figs. 10 and 13—reaches a maximum of twice the weight lifted. The maximum occurs after lifting 180 deg., the pull on the two sides of the pulley then being the same in direction and magnitude. The load on the shaft remains always the same, equal to the weight lifted, the reaction on the arm due to the belt pull on the pulling side being upwards, counteracting the downward pull through the pulley. In a 3-ton stamp the load on the pulley may reach 8 tons. Ordinary built-up pulleys, as used for power transmission, are not suitable for large stamps, the conditions demanding a strength best given by a steel casting.

### HOLDING-UP GEARS.

Lifters made with separate clutches are easily arranged with a brake wheel on the lifter arm, and gripping gear for keeping the tup suspended when required independently of the lifting clutch. Generally, however, a positive support under the tup is used. If the load could be instantly and automatically transferred from the lifting clutch to a brake, and the latter could always be relied on to be in order, the added complication and expense would be justified. Power would be saved and cooling arrangements probably dispensed with. So long, however, as the operator finds that he can easily hold the tup by the grip of the lifting clutch, the fact must be faced that a brake, should it get out of order, might remain unattended to, the stamp continuing to work quite well without it. The conditions encountered in the average stamping shop are unfavourable to any device not primarily of a labour-saving character or having a bearing on production. Extraneous devices, having for their main object the saving of power, unless the defects to which they may be liable are such as to inconvenience production, are apt to be allowed to fall into disuse.

The writer found recently that in a 40 cwt. stamp making front axles for motor cars, the saving in cost of electric current, if all holding up by the lifting clutch could have been avoided, would have been £50 to £60 per annum. This looks worth attention, but the case must be regarded as an extreme one, owing to the number of pauses during stamping, necessitated on such a job, and except with an instantaneous transfer device, it is not all realisable. The transfer can be carried out by arranging to have three definite positions of the operating handle, the extremes giving the up and down movements of the stamp, and a central position—to which the lever automatically tends to return—the suspension by brake. For the best control, however, a "hunting" movement of the control handle is necessary, and then only two functions are possible in practice, movement in one direction producing the rise, and in the other the fall of the stamp. The best way, then, of operating a brake is by compressed air. A small flexible pipe is carried down to the control handle, and fitted with a small valve, and the pressure of the fingers on a trigger causes the valve to open, allowing air to escape from the pipe, releasing the brake, and permitting the rise and fall of the stamp so long as the trigger remains pressed. At any instant the release of the trigger allows the brake to come into action, and the operator then, having raised the tup, releases his hold on the handle and effects the transfer of the load from the clutch to the brake. It will be clear, however, that only a proper sense of duty on the part of the operator will cause him to make full use of the brake, and if the operation of the lifting clutch is made easy—in itself a desirable thing—the brake may not be used much on the occasions when power could be saved.

## Electrical Engineering in 1921.

No. I.

THE conditions which prevailed in the electrical industry during 1921 did not differ widely from those experienced in many other industries, although it must not be imagined that nothing of importance was done. The general depresaion was, of course, felt by the firms that specialise in the manufacture of machinery and other electrical goods; but it would be erroneous to assume that during the period under review the electrical industry was to all intents and purposes dead. Electrical engineering has developed so rapidly during recent years and now enters into so many branches of work that anything approaching a cessation of operations is next to impossible. The fact remains, however, that the war has hindered progress to a deplorable extent. Had the state of affairs which existed prior to August of 1914 been maintained up to the present time there is no question that the review which we are about to present would have revealed important developments which, as matters stand, cannot materialise for a considerable time. It is not improbable, for example, that had it not been for the international unpleasantness we should now be writing on the inauguration of the electric train service to Brighton, Eastbourne, and other parts, the establishment of public charging garages for electric vehicles, the approaching abolition of gas lighting, and the rapidly increasing use of electricity on farms. As it is, the story we have to tell is of a relatively mild character. It relates mainly to extensions to existing power stations and industrial plants, improvements in the design of turbo-generator sets, developments in connection with transformers, and motors and electrical instruments.

Contrary to what many may suppose, there was during the year a good deal of activity in electrical works. Whilst exploring the shops of one of the large electrical manufacturers a few weeks ago we were glad to find that in all the departments important work was in hand, but most of it, we were told, was associated with contracts placed many months earlier, and the prospect of maintaining the output at the existing level did not seem particularly bright. This, it seems, is a condition which is not wholly confined to the firm in question. What appears to be causing anxiety in many quarters is the uncertainty with regard to the future rather than the question of keeping works running at the present time. In other words, there is a lack of new orders. From time to time possible obstacles to progress have been discussed by various prominent electrical men, such, for example, Mr. J. S. Highfield, who dealt with the matter from the point of view of the supply of electricity in his presidential address delivered before the Institution of Electrical Engineers. Several hindrances to progress, apart from those which are generally understood, were cited, such, for example, as the feeling of uncertainty and insecurity created by the Electricity Supply Bill in its original form; but the obstacle upon which Mr. Highfield seemed to lay the greatest stress was the purchase clause in the Provisional Orders. That clause, he said, severely hampered the industry and ought to be revoked unconditionally, as no single change would do more to promote enterprise and to supply the public at the least cost. All the technical improvements in sight would not, in Mr. Highfield's opinion, produce the beneficial results that would follow this change, for it would enable much obsolete plant to be scrapped, which must now be kept, and it would give heart to the director who desires to raise more capital and to push forward business, but who dare not and cannot raise money when he may be forced to sell the undertaking in a few years time.

### Propaganda Work.

Since its formation in 1919 the Electrical Development Association has done excellent work. Its function, as most of our readers probably know, is to popularise electricity. Many attractive little booklets dealing with various applications of electricity have been compiled and supplied to electricity supply authorities and others interested in the progress of electrical affairs. During the year under review the Association, which is now supported by a very fair number of municipal and company electric supply undertakings, manufacturers, &c., carried out a vigorous publicity campaign which undoubtedly helped to alleviate the unfavourable conditions that prevailed. The use of electricity in the home, the director and secretary of the Association tells us, is rapidly increasing, notwithstanding the increased price of current. We are, it seems, undoubtedly on the verge of vast development in this direction, and makers of domestic electrical appliances are, even under the existing conditions, enjoying good business. It is, of course, a perfectly well-recognised fact that progress in the heavier branches of engineering is largely dependent upon the kind of work which this Association is undertaking. The demand for large turbo generators and other central station equipment is governed by the demand for current, which depends in turn upon how much the public knows about the advantages of electricity. With all the Association's activities during the past twelve months we cannot deal. We may mention, however, that, in addition to the usual publicity work, steps have been taken, in conjunction with other bodies, to alleviate unemployment, and as a result of this an Act has been framed which provides for the postponement of interest and sinking funds on certain productive electrical works.

### The Electricity Commission.

The first annual report of the Electricity Commissioners, issued a short time ago, gives a summary of their proceedings up to March 31st of last year. At that date schemes had been submitted to the Commissioners in respect of five electricity districts—the Lower Severn, Mersey and West Lancashire, North Wales and Chester, West Riding (Aire and Calder), and the London and Home Counties districts—and in three of these cases the Commissioners had held local inquiries in accordance with the provisions of Sec. 5 of the Act of 1919, all the inquiries being in respect both to the area to be included in the proposed district and the scheme or schemes submitted. The position regarding these districts up to March 31st is dealt with in the report, and need not be considered here. Subsequent to that date the Commissioners have held local inquiries in respect of the West Riding, the London and Home Counties, and the South-West Midlands electricity districts. The Commissioners have also issued their decisions in respect of the North Wales and Chester, the Mersey and West Lancashire, the West Riding, and London districts. Owing to limitations of space, we cannot set forth all the details of these decisions, but we may recall that in the case of the London and Home Counties district the Commissioners have decided to set up a Joint Electricity Authority for the district, on which all interested parties will be represented, and have approved of the technical proposals for dealing with the requirements up to 1926, but with regard to the second stage up to 1930, they prefer to install the additional plant, estimated at 199,000 kilowatts, in a new capital station or stations on the riverside, a scheme which they believe will lead to economy of capital and running costs, representing an annual saving of more than £1,000,000. As immediate steps must be taken to commence work on this first new station, the Commissioners propose to authorise the County of London Electric Supply Company to proceed with its erection on the Barking site. They also favour the proposals to extend the tenure of the distributing powers held by the supply companies, coupled with a sliding scale of price and dividend. The rights of the Metropolitan and North Metropolitan Electric Supply companies will be respected, and they will be authorised to carry out the work of the Joint Authority in their respective areas. A number of important applications relating to the establishment of new stations were dealt with during the period ending March 31st, 1921, and in some cases new stations were sanctioned. Applications from some 120 authorised undertakings and four tramway and railway authorities for consent to extend existing stations were also dealt with. The sanctioned extensions up to the date mentioned represent plant capacity of approximately 547,000 kilowatts. Of this total approximately 415,000 kilowatts relate to local authority undertakings, 113,000 kilowatts to company undertakings, whilst the remaining plant, with a capacity of 18,740 kilowatts, is for tramway and railway generating stations. Under the provisions of Sec. 2 of the Act, the Commissioners prescribed or approved the kind of current, frequency and pressure to be used at new private generating stations belonging to ten owners. Formal consent was issued for the establishment of transmission lines in connection with the supply stations of the Corporation of Edinburgh, the Metropolitan Borough Council of Woolwich, the North Metropolitan Supply Company, and the Urban District Council of Erith.

At an early stage of the work, the Commissioners were faced with difficulties and complications arising from the existence of a multiplicity of frequencies, and it became apparent that immediate attention to the question of standardisation was necessary as a preliminary to proposals for the reorganisation of supply. Whilst the standard frequency of 50 cycles per second, recommended by the British Engineering Standards Association for all new systems, has already been extensively adopted, there are numerous under-

takings operating at odd frequencies, such as 100, 93, 87½, 60, &c., cycles per second, as well as wide areas of supply in which extensive developments have been carried out at frequencies of 40 and 25 cycles per second. Much attention was paid to the question of standardising frequency, but in view of the difficulties and expense involved, the Commissioners finally decided that there was no alternative but to defer for the time being the major question of framing a policy which would lead to the ultimate ideal of one standard frequency throughout the country. As an alternative, they decided that it should be their policy to eliminate all odd frequencies, with the object of bringing about a general consolidation of the prevalent frequencies in various districts and of reducing the number of main frequencies in use to three frequencies, namely, 50, 40 and 25 cycles per second.

**Power Stations.**

Whilst the Electricity Commissioners have consented to the erection of a number of new stations in various parts, and to the extension of existing stations, relatively few descriptions of work actually carried out were published during the period under review. The Portobello electric power station of the Edinburgh Corporation, which was dealt with in considerable detail by Mr. S. B. Donkin in a paper read before Section G of the British Association in Edinburgh, is one of the important stations which were under construction during the year. There are three sets, each rated at 10,000 kilowatts, but having a maximum continuous output of 14,700 kilowatts. The new Dalmarnock station which has been built by the Glasgow Corporation is, however, considerably larger than the station at Portobello. The main generating plant, in this case, consists of five 15,000-kilowatt turbo-generator sets, two of which were supplied by the Metropolitan-Vickers Electrical Company, one by the General Electric Company, and two by the English Electric Company, the turbine for the General Electric Company's sets being built at the Fraser and Chalmers works, which now belong to that firm. Each of these machines generates three-phase current at a pressure of 6500 volts, which is transformed up to 20,000 volts, at which pressure the current is transmitted to various sub-stations in Glasgow. Much progress was made in Lancashire and Cheshire in the development of high power generating stations. In Manchester, Salford, Runcorn and Blackburn a good deal of work has been done, and all the new stations are being built to conform with the conditions laid down in the Electricity Supply Act. On October 21st the new station at Blackburn was opened by Lord Derby. This station, which was described in THE ENGINEER on the opening day, contains at present two turbo-alternators, each rated at 10,000 kilowatts. A new station set to work at Runcorn has a capacity of 25,000 kilowatts. In order to serve its numerous works in and around Widnes, the United Alkali Company erected a new and up-to-date power station on the bank of the river Mersey, near the London and North-Western Railway bridge which spans the river between Widnes and Runcorn. When fully equipped the station will be capable of supplying 20,000 kilowatts, but at present only two 5,000 kilowatts have been installed. For several years past the generating plant at the hydro-electric works at the new Crane-street station of the Chester Corporation has been overloaded, and in August of 1919 negotiations were entered into for the acquisition of electricity supplies from H.M. Factory at Queen's Ferry, with the result that during December of 1921 a supply of electricity was derived from that source. The distance between Queen's Ferry and Chester is 6 or 7 miles, and the power is now being transmitted over this distance at a pressure of 33,000 volts, and is transformed down again at Chester to 6600 volts. A new 35,000-kilowatt station was opened by the Duke of York at Sheffield in November, but it had previously been in operation for a considerable time. Old and inefficient plant was replaced by new and economical plant in a considerable number of places, including Bolton, Bury, Darlington, Halifax, Hull, Salford, Sunderland, Warrington, and Wigan. During the period covered by the Electricity Commissioners' first annual report consent was given for the construction of a temporary 12,000-kilowatt station at Belfast; a station to meet an ultimate demand of 50,000 kilowatts at Leicester; extensions to the Barton station at Manchester; a temporary 4000-kilowatt station at Nottingham; and three small stations with capacities ranging from 66 to 264 kilowatts. Up to the time at which the report was compiled the Commissioners issued consents to five authorised undertakings and to three non-statutory undertakings in respect of permanent and temporary stations, representing an initial plant capacity of 150,000 kilowatts, but a much greater ultimate capacity. Since the publication of the report other applications have been dealt with. A complete list of consents issued by the Commissioners up to March 31st, 1921, in respect of the installation of additional generating plant is given in an appendix to the report.

**Turbo-generator Developments.**

In accordance with our usual custom, we have approached various electrical firms with a view to ascertaining the class of work they have done, and as is generally the case on these occasions, some of them have not responded. We are, however, able to state that the Metropolitan-Vickers Electrical Company carried out some very important work. Turbo-generating sets, with an aggregate capacity of 96,000 kilowatts, were shipped abroad, whilst sets representing over 280,000 kilowatts are at present on hand. For the Dalmarnock station of the Glasgow Corporation, two 18,750-kilowatt turbo-generator units were supplied, each having integral feed-water heaters and Baumann multi-exhaust blading. The results obtained with these heaters and blading are so satisfactory that the makers are adopting them in their standard designs, and a machine similar to those built for Dalmarnock has been supplied to the Clyde Valley Electrical Company. A 20,000-kilowatt set built on these lines is also ready for dispatch to Shanghai, whilst three 25,000-kilowatt machines are going through the shops for the Barton-street station of the Manchester Corporation. The Baumann multi-exhaust blading has enabled very large outputs to be obtained at high speeds. The adoption of factors of safety lower than those commonly employed do not, it is said, incur increased risks with this form of blading, but as the size of machines increases it is customary with this firm to increase the factory of safety. During the year the company installed in the Lister Drive power station of the Liverpool Corporation a 12,500-kilowatt 3000-revolution steam turbo-generator set, with an overload capacity of 25 per cent. for two hours. This is claimed to be the largest set running at 3000 revolutions per minute, and with the use of three-stage multi-exhaust blading, it has been possible to design the machine with wheel diameters which do not exceed those which have hitherto been employed on turbines of one-tenth this output. Nine similar sets have been ordered for our Overseas Dominions, and other sets designed for the same speed have been built for the Stepney Borough Council, the Croydon Urban District Council, the Southampton Corporation, the Salford Corporation and the Portsmouth Corporation. The limiting capacity of turbines in the past has been fixed by the area which is permissible in the last row of blades. For some time it appeared that it would be impossible to build turbines running at 3000 revolutions per minute for a greater output than 6000 kilowatts, but, as Mr. Baumann pointed out in his paper read before the Institution of Electrical Engineers last spring, the advantages of such high speeds as 3000 revolutions per minute can now be secured on machines of three times that capacity without the least difficulty. Just as the high-speed steam engine superseded the slow-speed engine and the high-speed gas or petrol engine the low-speed gas engine, so it is contended will the high-speed turbine with multiple exhaust blading supersede the turbines which have hitherto been restricted to 1500 revolutions per minute. Another development of considerable importance to power station engineers is the use of the special air cooler which is now generally supplied with the Metropolitan-Vickers turbo-alternators. In the past the ventilating passages in turbo-alternators became clogged on account of the accumulation of dirt. During a given time, approximately twice as great a weight of air passes through a turbo-alternator as of the steam which passes through the turbine to drive it, with the result that even if the air contains only a very small amount of dirt, the ventilation will sooner or later be impaired. There are, of course, various kinds of filters for purifying the air, but the conclusions arrived at by the engineers of the Metropolitan-Vickers Electrical Company is that they are unsatisfactory. To overcome the difficulty a number of experiments were carried out in connection with the cooling of air, and the outcome of these experiments was the development of a water cooler of the surface type, which is built into the foundations of the alternator. The water is taken from a branch of the circulating water main, and as there is practically no dirt in the system and as the same air is in circulation all the time, and does not come into direct contact with the water, the system has proved itself satisfactory from every standpoint. The General Electric Company turned out a very fair number of turbo-generating sets during the year, all the turbines being built at the company's Fraser and Chalmers' works. The capacity of the sets ranged from 1000 to 18,000 kilowatts, the speed being in most cases, we believe, 3000 revolutions per minute. Orders were placed with the company during the year for six turbo-generator sets for the Colonies. Three of these machines, which are rated at 3500 kilovolt-ampères, are for Pretoria; whilst two of 6000 kilovolt-ampères capacity and one of 4000 kilovolt-ampère capacity are for Auckland. Some British collieries are being supplied with G.E.C. turbo-alternators; also slow-speed alternators driven by blast-furnace gas engines. The largest turbo-generator set built by the British Thomson-Houston Company during the year was a 15,000 kilovolt-ampère set for the Glasgow Corporation tramways.

**Converters.**

Most of the large electrical firms, we believe, are building a fair number of rotary converters, although, of course, the principal demand for these machines arises in connection with electric traction systems which are not at the moment being developed. Some 2000-kilowatt G.E.C. rotary converters were built for the City of London Electric Light Company, and two 1000-kilowatt and two 1500-kilowatt sets were also built for the Charing Cross and West End Company. The Peebles-La Cour converter, made by Bruce Peebles and Co., Limited, of Edinburgh, is, it seems, still in considerable demand. There have, we are told, been very few, if any, years during which the Manchester Corporation has not ordered one or more of these machines. There are now, or will be shortly, no fewer than sixty-eight of these converters working on the Manchester system, the machines ranging in size from 100 to 2500 kilowatts. During the period under review this Corporation ordered two 2500-kilowatt and two 1500-kilowatt La Cour converters. Orders were also received for these machines from South Africa, India, Australia, Japan, Brazil, Holland, and Spain. For the Edinburgh Corporation the company secured orders for six 1500-kilowatt and two 500-kilowatt motor converters, two 500-kilowatt synchronous motor generators, a battery booster, and a large number of auxiliary motors for condensing and coal handling plants. A 250-kilowatt motor converter is also being built for the National Physical Laboratory. The rotary converters built in 1921 by the British Thomson-Houston Company were of average size. Considering the state of trade, this company states, the business in rotary converters was comparatively brisk. The most important orders received by this firm were for three 1500-kilowatt equipments for the Glasgow Corporation and seven 1000-kilowatt sets for the London County Council.

**Mercury Vapour Rectifiers.**

One of the most interesting developments in electrical engineering was the introduction of mercury vapour rectifiers into sub-stations. As far as this country is concerned these rectifiers have in the past been utilised mainly for small currents for charging small accumulators; but on the Continent larger units have been in operation for a considerable time. Their high efficiency over a wide range of load, simplicity, ease of operation, and low maintenance costs are advantages which ought not to be ignored by those who contemplate extending existing sub-stations or building new ones. It is perhaps too early to form a definite opinion as to the part that these rectifiers will eventually play in connection with converting current, for up to the present they have not been built for such big outputs as rotary converters or other machines which are commonly utilised for changing alternating current into direct current; but the recent installation of three relatively large units marks a distinct step forward. The first of these units was put down some months back by Power Rectifiers, Limited, in the new works of E. R. and F. Turner, of Ipswich. This rectifier, which has a capacity of 120 kilowatts, converts a three-phase, 3000-volt, 50-cycle supply into a 470–475-volt direct-current one, and although the load, which consists of cranes, compressors, &c., is of a highly fluctuating nature, we believe that we are correct in saying that no trouble of any kind has been experienced. The ability to deal with such loads without the least difficulty is in fact one of the advantages claimed for this class of apparatus. The second set has been put into operation in the War-lane sub-station belonging to the Birmingham Corporation. Originally this unit was rated at 500 ampères and 450 volts, which is equivalent to 225 kilowatts; but as it was found that this load could easily be exceeded, the working current has now been increased to 600 ampères. The primary three-phase supply pressure in this case is 5000 volts, whilst the periodicity is 25 cycles. The third set, which has been installed in the Tettenhall sub-station of the Wolverhampton Corporation, is approximately the same as the Birmingham plant, with the exception that it works at a periodicity of 50 cycles.

**Transformers.**

The chief progress made in transformer engineering was in connection with the construction of transformers for 33,000 and 66,000 volts. Although these pressures are not, of course, abnormal abroad, they have not in the past been widely adopted in this country. A good many medium and large-size transformers are, however, now working at a 33,000-volt pressure, which is one of the standard pressures recommended by the Electricity Commissioners for extensions and new systems. Marked progress has been made in the development of very large three-phase transformers, and six of 19,500 kilovolt-ampère capacity were ordered for Manchester. These, we believe, are the largest transformers that have been constructed in this country, and they are at present in the course of erection in the Metropolitan-Vickers Electrical Company's works. They weigh approximately 50 tons each, whilst the overall dimensions are 14ft. 6in. by 6ft. by 15ft. Outdoor transformer sub-stations have been in existence for some time abroad, and the practice of building these sub-stations has now been extended to this country, owing no doubt very largely to the present high cost of buildings. Waterproof transformers are now being built for pressures up to 88,000 volts. The Metropolitan-Vickers Electrical Company and Ferranti Limited are both engaged in this class of work

Johnson and Phillips, Limited, have built a large number of transformers for the Victorian State Railways, and we understand that the firm has also done a good deal in the way of developing extra high-pressure transformers for testing purposes.

**Electric Motors.**

Although there was, as usual, a material increase in the use of electric motive power, the electric motor manufacturers did not, of course, experienced such brisk business as they have done in the past. Electromotors, Ltd., state that, owing to the general depression, the year was a quiet one, and outside a few works' installations, the general run of business was of a normal character, calling for little in the way of fresh development. In the design of motors little change has been made, although there seems to be no doubt that motors which are not constructed on the usual lines are steadily coming into use. The Lo-thermo motor, made by this firm, is, we are informed, being put into service in many places which call for a thoroughly dust or waterproof machine. There is also a marked tendency to use certain modified forms of alternating-current machines which do not lower the power factor. The induction type synchronous motor, for example, is steadily gaining a footing. The advantages of these motors, as we have often pointed out, is that they will, if necessary, draw leading currents, which will compensate lagging currents in other parts of the system. Although these motors have now been on the market for a good time, they are not apparently over well known, for in the course of the discussion on Mr. H. A. Carr's paper on "Induction Type Synchronous Motors," read before the Institution of Electrical Engineers on December 15th, some of the speakers seemed to think that they were new. Several of the leading electrical firms are now making these motors, and during the period under review the Metropolitan-Vickers Electrical Company supplied six machines, one having a capacity of 1125 horse-power. The British Thomson-Houston Company also built a 1025 horse-power machine. Up to the present the synchronous type induction motor has been used mainly for driving compressors and fans, but they are equally well suited for driving other machines. Another motor which is beginning to acquire a certain amount of prominence in this country is the commutator polyphase machine, as exhibited at the Printers' Exhibition by the Swedish General Electric Company. The ordinary induction motor is not, of course, very suitable for speed variation, and, in addition, it tends to lower the power factor. With the polyphase commutator machine, however, fine speed variation can be secured without the use of wasteful resistances, and a good power factor can be obtained at various loads. The General Electric Company reports that during the period under review it supplied a large number of motors to collieries, ironworks and other industrial establishments, whilst Crompton and Co. have done a good deal of work in connection with the manufacture of induction type synchronous motors. The expansion of the use of electricity in coal mines is indicated in the second part of the annual report of H.M. Chief Inspector of Mines. Motors aggregating 1,080,822 horse-power are installed in coal mines, and aggregating 20,045 in mines under the Metalliferous Mines Acts. Three-sevenths of the mechanical coal cutters in use employ the electrical drive. In the period under review more than half the shots used for blasting were electrically fired.

**Electric Vehicles.**

Judging from reports which have reached us, the electric vehicle business was not nearly as brisk as it has been in the past, although, owing to standing orders which were placed during 1920, a good turnover was in some cases realised. There was a fair amount of activity in the direction of designing new vehicles, and, as we announced at the time of the Commercial Motor Exhibition, two additional firms —Guy Motors, Limited, and Clayton Wagons, Limited—have joined the ranks of electric vehicle builders. The General Vehicle Company reports that during the year it supplied vehicles to corporations, railways, haulage contractors and industrial concerns, and also sent vehicles abroad. The company has reorganised its works, and has a fixed production schedule, which it has so far been successful in keeping pace with. During the year the company also slightly altered its standard design by providing a roller battery cradle on all vehicles, so that the battery can easily be drawn out by one man. The controller has also been placed in a fire-proof box and has been made more accessible. Electricars, Limited, has developed new 2½–3-ton and 3½–4-ton chassis, which are said to have proved under vigorous tests to be thoroughly reliable and otherwise good. These chassis, which are already in use in many important industrial towns in the British Isles, are being used for various classes of duty, ranging from ordinary commercial carrying work to passenger omnibus service, and in connection with special vehicles, such as tipping wagons for municipal purposes, street-watering vehicles, &c. The new vehicle, which has been placed upon the market by Clayton Wagons, Limited, of Lincoln, and which we hope to describe fully on some future occasion, is a 4–6-ton electric wagon with a tipping body. Ransomes, Sims and Jefferies, of Ipswich, introduced a new 2–2½-ton vehicle with a rear chain drive. They are also offering, in addition to their other models, a 4½–5-ton vehicle, which also has a rear chain drive. The firm, during the past twelve months, adapted its electric vehicles to various uses, in addition to that of simply transporting goods. Perhaps the most notable development in this connection was the fitting of a 1-ton crane to the firm's 3½–4-ton vehicle chassis, thus enabling it to be used as a mobile crane for unloading ships at docks. The crane used was manufactured by Cowans, Sheldon and Co., who also fitted it to the chassis. The range of the Ransomes, Sims and Jefferies electric trucks has been extended, and various attachments have been introduced to enable them to comply with special conditions met with in various industries. A truck has been designed, for example, for lifting an ordinary omnibus body and for transporting it between different parts of a body works. Another truck has been designed for handling annealing pots, &c., in annealing ovens. The firm has also developed a runabout crane, as described in our issue of October 21st, 1921. Newton Brothers (Derby), Limited, had apparently a fairly good year. A vehicle recently designed by the firm has a cab with a front entrance, which enables a number of these vehicles to be garaged with the hubs together, thereby saving a considerable amount of space. Other special features claimed are ample ground clearance, and a removable front plate, which when taken down reveals all the connections, so that any faults that may have developed in the wiring can easily be attended to. A good many other particulars relating to various sizes of vehicles have been brought to our notice, but we are unfortunately unable, owing to limitation of space, to deal with them on the present occasion.

## Water Supply in 1921.

**The Drought.**

THE year 1921 will be long remembered by many waterworks engineers as a period of great anxiety. After a rather wet summer in 1920, there were, over a large portion of the country, a persistent series of rainless periods, one of them constituting the worst drought within living memory. For a large portion of the year the whole country, with the exception of a few favoured areas, suffered from a pronounced shortage of water. The northern districts, considered as a whole, obtained relief earlier than was the case in the south, but even so, almost at the end of the year there were parts in the North, especially in the West Riding of Yorkshire, in which there was still a scarcity which in many cases was severe. In the South scarcity was the rule rather than the exception. In London, thanks to the excellently amicable coworking of the Water Board and the Conservancies of the Thames and Lea, there was—we believe we are right in saying—no curtailment; but in other parts there were stringent restrictions on consumption, restrictions which, it may be added, it has not been as yet possible in every instance to rescind. Indeed, in some cases the scarcity still remains acute, and unless heavy and continuous rainfall is experienced early in the New Year, the shortage over a wide area is likely to continue to be felt. It is quite possible that districts in which the supply has hitherto held out will, during the forthcoming months, feel the baneful results of last summer's lack of rainfall and prolonged high temperatures.

**General Survey.**

On the whole a little more has been done in waterworks engineering during the past twelve months than has been the case for the last few years. Even so, however, constructional work has not by any means reached pre-war level, and with prices and financial and other conditions as they are there appears to be but small chance of a speedy return to that condition. It is true that a certain amount is being done in the way of attempting to solve the problem of unemployment by finding occupation for those badly in need of it; but even so, the work is, for the most part, only of a more or less preliminary character, and in any case forms but a small fraction of what is calling aloud for execution. For the moment, it does not seem as though the forthcoming year were about to witness any great improvement in this direction. There are even fewer Bills before Parliament than was the case last year, and it seems only too likely that until economic conditions improve generally, many works, including some which are of pressing importance, will be held over. In spite of what has been said in the foregoing, however, a not inconsiderable amount of work in the aggregate has been carried out, as will be seen in what follows.

Water Bills occupied a considerable portion of the parliamentary session, most of the Bills being for increased charges, owing to the general rise in wages, materials, &c., though many of them were for new works. The Sunderland and South Shields Company, for instance, applied for powers to sink new wells; Preston for powers to extract further water from the Hodder; Greenock asked for the sanction of a scheme involving the purchase of power water, and was successful; the Rotherham Corporation applied for powers for sinking a well in the red sandstone formation in Yorkshire, but its Bill was thrown out; and Southampton successfully promoted a Bill for the purchase of the South Hants Water Company. Croydon sought sanction for sinking a well in the chalk, but the opposition from the Wandle Preservation Society, the South-Western Railway and others caused the Bill to be thrown out. The East Surrey Water Company, on the other hand, was successful in getting parliamentary sanction for the sinking of a further well in the chalk formation. The South-East Essex Water Company promoted a Bill for taking the waters of the river Stour, but it was unsuccessful. The Bill of the Metropolitan Water Board, to which we referred in our annual article last year, received Parliamentary sanction.

Doncaster completed a new bore-hole, 320ft. deep. It is said that it has been proved possible to pump 850,000 gallons of water per day continuously from it.

**The Littleton Reservoir.**

Considerable progress has been made during the year with the construction of the Littleton reservoir of the Metropolitan Water Board, the contractors for which are S. Pearson and Son (Contracting Department), Limited. The water surface area of the reservoir when this latter is completed will be approximately 700 acres, and the capacity about 6,500,000,000 gallons. Like all the other reservoirs constructed by the Board in the Thames Valley, the reservoir will be formed of an earthen embankment with a central puddle core tied into the surface of the London clay. The water will be pumped into it from the Thames, the intake, which is near Penton Hook, being controlled by roller sluices. Three Venturi meters, each having a throat 4ft. 10in. in diameter with a maximum capacity of 100 million gallons per day, will be installed at the commencement of the intake channel. The outlet from the reservoir will be controlled by six roller sluices having openings 5ft. wide and 6ft. deep into a draw-off tower which stands in the reservoir. The shaft of the tower will be connected to another shaft just outside the puddle core. by means of a tunnel 9ft. 9in. in diameter, formed of cast iron segments lined with concrete and brickwork. From the outer shaft the water will be drawn off by means of two 8ft. diameter reinforced concrete conduits controlled by roller sluices. The formation of the embankment and puddle core wall is in progress along the northern and eastern sides. The puddle trench has been finished along the northern side, and the excavation and puddle filling along the western and eastern side is proceeding. The outlet shafts have been completed to just below the level of the top of the embankment. The tunnel connecting the two shafts is finished and the twin outlet conduits have been constructed for a length of 175ft. The contract for the pumping machinery for lifting the water from the river into the reservoir has been let to Worthington, Simpsons, Limited. It will consist of four units of uniflow engines driving centrifugal pumps, each unit having a capacity of 75 million gallons per day against a head of 37ft., with a possibility of an overload of 25 per cent., giving 780 pump horse-power per unit or a total horse-power of 3120. The delivery will be through three steel pipes 6ft. in diameter laid over the embankment.

**Other Works of the Metropolitan Water Board.**

In the Board's Kent district additional service reservoir capacity over and beyond the reservoirs at Westerham Hill, Betsom's Hill and Shooter's Hill, which were completed in 1920, has been and is being provided at Eltham, Farnborough, Bromley and Bickley. The reservoirs at the two first-named places are finished and the construction of the other two is in progress. The Bickley reservoir is to have a capacity of 1½ million gallons, while that at Bromley is to hold about 5 million gallons. Both will be covered in.

A 48in. main is now being laid from Walton to Brixton, from which point it will be continued as a 36in. main to the Honor Oak reservoir, with branches to augment the supply in various areas in the Southern and Kent districts. A commencement has been made on the enlargement of the existing pumping station at Walton, so as to provide for the installation of pumping machinery for an additional supply of filtered water through the main just referred to. The contract for the first portion of machinery in question has been let to Hathorn, Davey and Co. It will consist of one triple-expansion marine type engine with reciprocating pumps, having a capacity of 17.5 million gallons per twenty-four hours against a head of 260ft., and of 955 pump horse-power. There is also to be a stand-by unit of the same power, consisting of a steam turbine by Belliss and Morcom, Limited, driving centrifugal pumps of Mather and Platt's manufacture. Designs are in course of preparation for the installation at Walton of primary rapid gravity filters, followed by slow sand beds, filtering at a rate twice to three times that normally allowed through the Board's existing filter beds.

A duplicate well has been sunk at West Wickham, and a contract has been let for the supply and erec-

tion there of additional pumping machinery, with a capacity of 2½ million gallons per day against a total head of 400ft. At Well Hall-road, Shooter's Hill, a cottage and a new engine-house, containing three electrically driven centrifugal pumps of a combined capacity of 3½ million gallons per day and 146 pump horse-power, have been erected. At Eynsford, in Kent, the sinking of a well is in progress the work being effected by direct labour. The well is 9½ft. in diameter, and is lined with concrete for a depth of 7ft., below which a lining of cast iron segments is carried down to a depth of 56ft. 8in. on a steel ring supported on an underpinning of brickwork, &c. The remainder of the depth will be in bare chalk. At the Hampton works two Diesel engines, driving centrifugal pumps, each having a capacity of 4½ million gallons per twenty-four hours against a total head of 270ft., or a combined horse-power of 512, have been erected and are nearly ready for work. These, together with three oil tanks, constructed out of old boilers, are installed in disused buildings which have been adapted for the purpose. They will form a stand-by to the existing machinery at this station. The Board is also installing in an existing disused engine-house at the Lee Bridge pumping station a triple-expansion marine type engine with reciprocating pumps. This engine has a capacity of 14 million gallons per day against a head of 200ft. or 588 pump horse-power.

**De-ironing Water.**

The water from the Metropolitan Water Board's wells at Waltham Abbey and Rammey Marsh having become charged with iron, it was decided to lay down a plant to deal with the trouble. The work is now nearing completion. The plant installed consists of twelve Candy iron-removing filters, each of 8ft. 3in. internal diameter and about 7ft. high. The filtering medium consists of aerating and iron-removing sand and polarite. A small quantity of compressed air will be injected into the unfiltered water for the oxidisation of the iron in solution. The polarite acts as a catalytic agent, transferring the dissolved air to the iron with which it combines to form an insoluble hydrated oxide of iron. By this means it is hoped to reduce any iron which may be contained in the water to be treated to 0.01 parts per 100,000. Ten of the filters, which will together be capable of treating 2 million gallons of the water in twenty-four hours, will usually be in service together, the remaining two acting as spares. For working the filters, a compressor plant, driven by Pelton wheels, has been installed. The whole of the apparatus is enclosed within a brick building, having a reinforced concrete roof. The subsoil on which the building had to be erected is of a peaty nature, and is charged with water. It was consequently necessary to support the filters, and the building on a reinforced concrete foundation supported on reinforced concrete piles.

**Birkenhead's Supply from Lake Alwen.**

After taking some ten years to construct, the works necessary for conveying to Birkenhead the water impounded by the Alwen dam were completed during the year, and the supply was formally turned on in the middle of August. The ceremony, it is interesting to note, was performed by Alderman Henry Bloor, who also, in 1911, had laid the first stone of the dam. The reservoir formed by the dam has an approximate length of 3 miles and an average width of about one-fifth of a mile. The water area of the lake is 365 acres, and the volume of water held up is over 3,000,000,000 gallons. It is calculated that the daily quantity of water available will amount to 10,800,000 gallons, and as 3,600,000 gallons has to be allowed to flow down the bed of the river Alwen as compensation water, the quantity which will remain for use in Birkenhead is 7,200,000 gallons per day. The dam, though curved in plan to a radius of 500ft., is nevertheless of gravity section. It reaches to a height of some 100ft. above the original bed of the stream, but is only 375ft. long at crest level, the configuration of the valley at the point chosen for the structure lending itself so thoroughly to the purpose required. The overflow sill is at an elevation of 1190ft. above Ordnance Datum. The aqueduct which conveys the water from the reservoir to the town is about 42 miles long. The greater portion of it consists of cast iron pipes from 36in. to 19in. in diameter, but there are in its course four tunnels, which are respectively 170 yards, 350 yards, 250 yards, and 175 yards in length. The third —that 250 yards long—is the most interesting, since it takes the water under the river Dee. For constructing it, it was necessary to sink two shafts, one on either bank of the river, and to cut a circular tunnel between them by means of a shield, the tunnel being lined with cast iron segments as are the London tube railways. Some little difficulty was experienced in running the pipe line over the marshes on the shore of the river immediately after leaving the shaft on the English side. At first it was proposed to carry it on steel piles in shallow trenches, but the nature of the subsoil rendered that course impossible, and eventually it was decided to lay the pipes on the surface of the ground and to cover them with earth, a method which has, so we understand, answered admirably. A feature of considerable interest in the undertaking is the covered service reservoir at Cross Hill, which contains no less than 30,000,000 gallons. The area of this reservoir is such that each foot depth of water represents 1,000,000 gallons. At Clawdd Newydd, 10 miles distant from the dam, and at Mount Pleasant, to the north-east of Mold, break pressure or balancing tanks have been constructed in the aqueduct, the water level in them being 995.5ft. and 521.0ft., respectively, above Ordnance Datum. The top water level in the Cross Hill reservoir, is, it may be mentioned, 233ft. above Ordnance Datum.

**Cardiff's New Waterworks.**

Following a strike of the navvies and labourers on the Llwynon reservoir works which commenced on August 7th, 1920, and only terminated on January 31st, 1921, work generally was resumed. Since that date good progress has been made in connection with the puddle wall and embankment, which has now been brought up to about 40ft. above the river level, leaving another 42ft. to the top of the puddle wall and 44ft. to the top of the embankment to be constructed. The valve shaft masonry has also been continued to a few feet above the embankment. During the dry weather in the summer it was possible to execute the concreting of the pool. The excavations for the byewash have been proceeded with, and the granite steps and walls carried up in connection therewith. A masonry bridge has been built on the western road diversion and a considerable portion of the diversion itself carried out. A large quantity of stone has been quarried from the Corporation's quarry, which is some two miles distant, and conveyed to the site of the works by the Corporation's railway, where the dressing, &c., has taken place. A further number of huts has been constructed for the use of the men engaged upon the work, and provision made for recreation, &c. During the last few months the weather has been favourable for the work generally, and it is hoped to be able to impound water in the reservoir in two years' time. The total capacity of the reservoir when completed will be 1260 million gallons.

A commencement was made just before the end of the year with the foundations and pipelaying in connection with roughing filters which are being erected near the existing Cantreff reservoir, so that the whole of the water may be rough filtered before entering the aqueduct. Three new filter beds have been added for the use of the high level service, a work which entailed the reconstruction of the large mains in connection therewith and the fixing of a new 20in. Venturi meter. The excavations and embanking in connection with the Wenallt reservoir are being carried out. The reservoir will have a capacity when built of 15 million gallons, and it is expected to take two years to construct. A considerable mileage of trunk mains, varying from 30in. to 12in. diameter, has been laid during the year. All the foregoing have been or are being carried out by direct labour to the designs and under the supervision of Mr. C. H. Priestley, the Corporation's waterworks engineer.

**Cowlyd Dam.**

An interesting undertaking which reached its concluding stages during the year was the construction of the Cowlyd dam; and not the least interesting feature is that the impounded water serves two entirely distinct purposes. It will not be necessary in the present instance to go further in detail into the why and wherefore of the matter than to say that originally the water in the lake was impounded by a low dam built by the Conway and Colwyn Bay Joint Water Board in 1892. There are, in fact, three adjacent lakes known locally as Llynns Dulyn, Melynllyn, and Cowlyd, which are all utilised for supplying drinking water to Llandudno, Conway, Colwyn, the surplus water flowing from them being used to generate electricity in the power station at Dolgarrog, on the river Conway, of the Aluminium Corporation. The latter, desiring to obtain a larger supply of water, undertook to build another and higher dam, just below the original Cowlyd dam, the new structure raising the level of the lake by 37ft. and increasing the storage capacity by some 2350 million gallons. The agreement between the Board and the Corporation is, in effect, that the latter may take as much water as it requires providing that it does not reduce the water level below that of top-water level in the older and smaller reservoir, and the invert of the Corporation's draw-off pipe has, accordingly, been fixed at that level. The total length of the new dam, which is of earth, is 450 yards, and its maximum width at the base is 216ft. There is a core wall of concrete which, at its lowest point, had to be taken down to a depth of 50ft. below the original ground level. The spillway, which is 160ft. wide, is at an elevation of 1206ft. above Ordnance Datum.

**The Scar House Hydro-Electric Plant.**

Another noteworthy plant, though it has to do only indirectly with water supply, is the hydro-electric power-house which has been erected by the Water works Department of the Bradford Corporation, and which was formally opened in the middle of December. The power-house, which draws its supply of water from the Angram reservoir, will be employed to furnish the electrical energy which will be required to operate the machinery—cranes, overhead ropeways, crushing plant, concrete mixers, &c.—necessary for the construction of a new reservoir, to be known as the Scar House reservoir, which Bradford is about to construct. The generating plant comprises two high-speed Francis type turbines, each of 295 horse-power capacity and each coupled to a 250 k.V.A. three-phase alternating current generator. There are to be four converting sub-stations at different points on the site. The water, after passing through the turbines, will be led into the aqueduct which conveys the water to Bradford.

**New Pumping Engine at Margate.**

Margate has carried out some useful extensions of its water supply undertaking. Under the direction of Mr. Ernest Borg, the Corporation's engineer, an existing well at Wingham pumping station has been enlarged and a considerable additional supply of excellent potable water has been secured. It was necessary to lift the water thus obtained through a height of 130ft. to the surface, and then to force it for a distance of nearly 15 miles against a head of 300ft., inclusive of pipe friction, to the reservoir at Margate. The engine for the purpose, which has been supplied by Hathorn, Davey and Co., Limited, is of the vertical triple-expansion Corliss type. It operates, first of all, a three-throw bucket pump in the well, to lift the water to the surface, and also three vertical plungers arranged below the steam cylinders and operated directly from the crossheads, to force the water through the rising main to the town reservoir. The engine, which has to deliver up to 4,000,000 gallons of water in the 24 hours, has cylinders 20in., 36in., and 53in., in diameter by 4ft. stroke. The well pump buckets are each 16in. in diameter and the force pump plungers each 15½in. in diameter. The speed is 25.7 revolutions per minute. On trial the overall mechanical efficiency of the engine and pumps was found to be on one occasion 92.6 per cent. and on another 90.9 per cent.—an average of 91.75 per cent.—while the mean steam consumption per actual pump horse-power in water lifted worked out at 12.23 lb.

**Compensation Water for the River Don.**

Our readers will remember that in our annual article of two years ago we made mention of the fact that Sheffield had obtained permission to divert some of the compensation water flowing from the Damflask reservoir into the river Don and replace it with a mixture of river water and effluent from the sewage works which was to be pumped from a point below the town to a point well above it. It was originally sought to take powers to abstract as much as 9,000,000 gallons per day, but Parliament refused to allow more than 4,000,000 gallons to be taken. The water, at the point where the abstraction is made, is of excellent quality and perfectly suitable for dietetic purposes, though anyone acquainted with the river during its passage lower down its course through the city would ever imagine that in its upper reaches the stream was of a quite perlucid character. The argument put forward was that a mixture of river water and a purified, clarified, non-putrescible effluent could not possibly be worse than the water in the river, and would, in fact, be better, so that no ill-effects could be experienced from such a course, and further, that it would set free a large volume of pure upland water for the domestic needs of the city. The scheme was, during the year, completed and put into service. It has been found, so we understand, to work excellently in practice and to have fulfilled all expectations. The co-ordination of the necessary operations, which must be synchronised so as to obtain the maximum of efficiency and economy has been effected very satisfactorily, and the difficulties met with in carrying out such an undertaking on an unprecedented scale have been successfully overcome. The result is that Sheffield has been able to add to its daily supply as many as 4,000,000 gallons of good potable water which it would have been difficult and costly to obtain in any other way.

**Leicester's New Filtration Plant.**

In April the formal opening took place of the new mechanical filtration plant which the Leicester Corporation has installed at Hallgates. The plant is of considerable magnitude, being intended to deal with six million gallons of water per day. There are in all forty No. 8 filters, supplied by Bell Brothers, of Manchester. Each is 8ft. in diameter and the filtering material is Leighton Buzzard sand. The filters are arranged in batteries of five for convenience of washing, each battery being laid off in turn for cleansing by reversal of flow. The coagulants used are lime and sulphate of alumina. The addition of the chemicals is quite automatic. The standard lime mixture is made in six steel chambers, 20ft. high, by passing water through beds of lime placed in the bottoms of the chambers. The lime water is introduced into the raw water by means of a Venturi tube, the difference in pressure between the inlet and the throat being sufficient to induce the flow. As the quantity of water passing into the filters increases or decreases, so the quantity of lime water increases or decreases in exactly the same ratio. The sulphate of alumina is dissolved in reinforced concrete tanks and flows thence to balancing tanks in the filter house. The solution is pumped into

the filters by means of turbines which are driven by the flow of water entering the filters, so that in that case also, the ratio of chemical to flow of water is kept constant. The filtered water passes into the Corporation's Cropston service reservoir. The power required to drive the plant is derived from two 13 horse-power oil engines, one of which acts as a stand by. The engines drive a dynamo which supplies current to motors placed at each end of the filter house. The dynamo also charges a battery of accumulators which supplies current for lighting the filter house and the attendant's cottage.

**Manchester's Water Supply.**

During the year the only work that has been done in connection with the Haweswater scheme consisted in the erection of a number of weir gauges on the main streams which receive the drainage of the watershed. As regards the Thirlmere supply a contract was let for about 4¼ miles of "Bonna" steel-reinforced concrete pipes to form part of the fourth conduit between the lake and Manchester, the contractors being Hughes and Lancaster. The pipes are to be laid at the southern end of the Ribble syphon which has a total length of about 9½ miles. It is intended to manufacture the pipes on a site adjacent to the aqueduct near Longridge. The site has already been secured and the necessary plant is being erected. The other syphons of the fourth pipe line will be composed of welded steel pipes 54in. in internal diameter. The contract for the latter has also been let, the contractors in this case being the British Mannesmann Tube Company. Work on the construction of the service reservoir at Heaton Park has been resumed, and the intention is to push on with it as quickly as possible so as to ensure its completion by the time the fourth pipe line from Thirlmere is ready for use. Nothing has been done in connection with the Longdendale undertaking, but it is understood that a start will be made early in the New Year on works for increasing the storage capacity in that valley.

## The Corrugation of Tramway Rails.

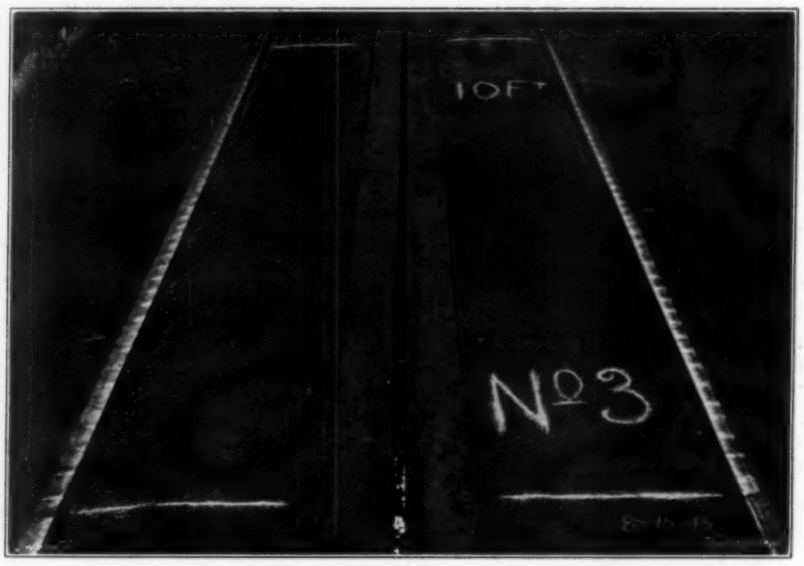
WE have been favoured by the receipt of a copy of the final report presented to the Municipal Tramways Association by its Rail Corrugation Sub-committee No. 1, appointed some time before the war to investigate the corrugation of tramway rails, with particular reference to the vibration of the rails and foundations as a cause thereof. The committee consisted of Mr. W. W. Beaumont (chairman), Professor Carus-Wilson and Messrs. A. L. C. Fell, H. J. Howley, W. E. Ireland, A. H. Pott and J. Welling. Its work and observations have been principally carried out in the London County Council's tramway subway below Kingsway, a portion of track ideally suited to the purpose by virtue of its protection from the weather, its straightness and levelness, and the absence of traffic other than tramway cars. The cars running through the subway are of the single-deck type, seating thirty-six passengers and weighing 14½ tons empty. They are mounted each on two "maximum traction" bogey trucks and are fitted with two 42 horse-power motors. The trucks have steel tires, the diameters of which are 31¾in. and 21¾in. on the driving and pony wheels respectively. The speed of the cars varies from slow to 20 miles an hour.

A photographic view showing typical corrugations on the tracks as laid in the subway is reproduced herewith. The corrugations have pitches of about 2½in. on the average and depths ranging from 0.004 to 0.008in. Suggestions had been made that they owed their origin in some way to vibrations in the rail or foundations set up by the passage of the cars. The committee closely investigated this possible cause of the trouble. With a view to restraining vibration sections of the track were re-laid with 6in. by 3½in. by ½in. angle irons bolted to each side of the rail web. Over another portion heavy cast iron blocks were similarly bolted to the webs, while in addition the ordinary longitudinal wooden sleepers on which the rails rested were replaced by short lengths of old rails laid cross-wise at 7ft. 6in. intervals, the whole being concreted up to the level of the top working face of the track.

The rails stiffened as above mentioned and otherwise, as well as some manganese rails and some ordinary rails treated with the Zell process, were kept under observation for a period of over six years. It was found that all developed corrugations, and in particular that those specially stiffened against vibration showed no appreciable difference in this respect from the rest of the track.

The conclusion has therefore been arrived at that the question of vibration has little or nothing to do with the cause of the corrugations. Instead, it is regarded as established that the origin is to be found in the action which occurs when the heavily loaded wheels roll along the surface of the rail treads. This action, it is held, gives rise to superficial stresses in the material of the rail which are in excess of the elastic limit of the steel. The material therefore flows into the form of waves much after the manner in which an ordinary road surface is waved by the action of a steam roller while it is being laid.

It is presumably to the smaller pony wheels rather than to the larger driving wheels that the chief corrugating effect is to be ascribed. The total load on each wheel, it will be noticed, averages when the car is loaded just about 2 tons. From experiments made by Mr. Beaumont on the area of contact between the wheel and rail, it is to be concluded that such a load gives rise to stresses in the centre of the area of probably as much as 50 tons per square inch when the car is stationary and of some 90 tons when it is running at ordinary speeds on straight portions of the track. When rounding a corner at speed with the car heeling over, the stress, it is believed, may be as much as 120 tons per square inch.




CORRUGATIONS ON L.C.C. TRAMWAY RAILS

## Brazilian Centenary Exhibition.

ON December 28th the Prefect of Rio de Janeiro laid the foundation stone of the pavilion, which is being built for the accommodation of British exhibits at the forthcoming Brazilian Centenary Exhibition. The Exhibition, which will be universal and international, is being organised by the Brazilian Government in connection with the celebration of the centenary of Brazilian independence. Invitations to participate have been accepted by most of the leading powers, and our chief competitors in the Brazilian market are making great efforts to further their interests by taking full advantage of the opportunity which the exhibition offers for trade propaganda and advertisement. The United States has voted a million dollars for official participation, while the Belgian Government, in addition to a National Pavilion, intends to build an exhibiting hall with an area of 70,000 square feet, and there is every indication that other countries mean to be very strongly represented.

In view of the activities of other countries it is essential that the British section should be thoroughly representative. While it is true that the present state of the Brazilian exchange militates against the hope of immediate business on a large scale, it is also true that the Brazilian market possesses many special attractions for British traders and should not be ignored. There can be no doubt that the Brazilian people are strongly predisposed in favour of British firms and British goods, the reputation of both standing even higher than before by reason of the contrast with the quality of the goods and the methods of other nations who took advantage of the war to exploit the Brazilian market. An indication of this strong pro-British sentiment may be found in the fact that although financial stringency prevents this country from participating on such a lavish scale as certain other nations, it has nevertheless been allotted the best site in the whole exhibition area. The British section has received not only the moral support of Anglo-Brazilian commercial interests but also substantial financial assistance. A Committee, of which Mr. Lionel de Rothschild is chairman, was formed to co-operate with the Department of Overseas Trade, and has collected funds which will defray nearly half the cost of this country's participation. Full particulars regarding rates for space can be obtained from the Department of Overseas Trade.

Brazil is a very valuable market for imported goods of many descriptions. The fourth largest country in the world, it occupies one-third of the whole of the South American Continent. Primarily of an agricultural and mining character before the war, it was, during the war, very largely thrown upon its own resources by reason of the inability of the great manufacturing nations to satisfy its demand for manufactured goods, with the natural result that a considerable fillip was given to the development of manufacture in Brazil, which was already before the war beginning to grow. The development of manufacture within a country, however, spells a large demand for imported goods in the form of machinery and equipment for the factories; nor is Brazil in a position to supply more than a proportion of the demand for the manufactured goods of the kind produced in that country. The political and commercial ties between Brazil and the United Kingdom have been close for upwards of a century, and British goods of all kinds command in Brazil an unrivalled reputation. Apart from the fact that political relations between Brazil and this country have always been of a friendly character, the total British capital invested in the country, exclusive of that invested in banking, shipping and telegraphs, aggregates approximately £250,000,000. The payments due to this country by way of interest, dividends or profits on these investments, result in a steady flow of money to this country from Brazil, or, alternatively, in a demand for British goods for Brazil.

Brazil, like many other countries, is at present passing through a period of commercial depression, and the depreciation in Brazilian purchasing power renders it unreasonable to anticipate that imports will, for some time to come, approximate to those of 1913 in weight or to those of 1920 in value. At the same time, however, Brazil has passed successfully through crises before, and, as a young and progressive country, of great natural wealth, it is certain to provide a large market for British goods for many years to come.

## ELECTRICAL ENTERPRISES IN VICTORIA.

THE second annual report of the Victorian Electricity Commission, which is controlling the extensive task of establishing the new scheme whereby electricity is to be generated at the Morwell Brown Coal Mines, 90 miles from Melbourne, and transmitted to Melbourne, was issued towards the end of last year. The report consists chiefly of a review of the preliminary work, leading up to the acceptance of tenders for the supply and delivery of plant and apparatus. Practically the whole of the contracts had been awarded, and in most cases manufacture was proceeding rapidly.

Until June, 1923, when it is expected that the Newport "B" power station will be in operation, the Commission is to be supplied with a maximum of 12,500 kilowatts of 25-cycle energy from the railway power-house for distribution and re-sale to consumers other than the railway department. The Commission has the right to purchase for distribution and re-sale all electrical energy—the production of either or both power-houses—which might be surplus to the railway requirements, this surplus being over and above the 12,500 kilowatts referred to. When the new Newport station and the Morwell power station are in operation both these stations and the Newport railway power station will be linked. The State-owned stations will thus be in the position of rendering mutual assistance in the event of a breakdown at any one of the stations. The Commissioners, in instructions to the contractors, have laid special stress upon the urgency of having the new station in operation by May, 1923, in order to relieve the electric supply position.

Up to the present boring of the coal area at Morwell has been carried out only on the western side of the Moe-Morwell railway line. Arrangements have been made with the Mines Department to explore the ground on the eastern side of the line to ascertain whether the deposits of brown coal continue in that area, and to determine their nature and extent. The Commission is devoting some attention to the utilisation of pulverised brown coal as fuel, and plans have been prepared for the installation of an experimental plant for the production of brown coal in a powdered form.

In November, 1920, the Commission recommended to the Ministry that the Kiewa scheme should not be proceeded with, as the existing demand of the metropolis was not sufficient to justify its embarking on the execution of a hydro-electric scheme of the nature and magnitude outlined. The Commission proposed to continue hydro-electric investigations on a more modest scale for the service of north-eastern towns or groups of towns. Instructions have therefore been issued to investigate further the resources of the Sugarloaf Weir, Rubicon River, and Snobb's Creek with this object in view. The Commission declared that it hoped to present to the Government early this year a definite scheme for the utilisation of these particular water power resources. It was also stated that a survey party in the Snowy River district was investigating the possibility of electric supply from the water power resources of that district.

ANOTHER investigation as to the rates charged by American railways has been commenced. The Inter-State Commerce Commission, on November 23rd, ordered an inquiry as to whether, and to what extent, if any, further general reductions in rates, fares and charges can be made. It is significant, too, that a supplementary order added "also to determine what will constitute a fair return from and after March 1st, 1922, under section 15*a* (3) of the Inter-State Commerce Act." This section provided that the charges were to be sufficient to give the companies a return of 5½ per cent.—in most cases 6 per cent.—up to March 1st, 1922. This figure has not been even approximated; the actual result has been less than one-half this percentage.

# A Seven-Day Journal.

## Railways and Road Transport.

THE announcement that some railway companies intend to apply for parliamentary powers to take a larger share in road transport has revived the opposition of existing road transport interest. An appeal has been issued to members of the House of Commons by the Industrial Vehicle Section of the Automobile Association and Motor Union. It is pointed out that the proposals of the railway companies, if carried into effect, would give powers to the companies obtaining the necessary authority to operate road transport for goods and passengers irrespective of whether the traffic had been or would be in contact with the railway system, and to charge such rates and fares as they pleased subject only to certain provisions of the Railway and Canal Traffic Acts. Fears are expressed that with their enormous financial backing it would be comparatively easy for the railway companies to wipe out of existence all the present individual firms engaged in motor haulage or the motor coach business, thereby creating what would be virtually a monopoly in transport by road as well as rail. There is really nothing new in these arguments, and they do not gain strength by frequent repetition. Many people hold the opinion that the existing road transport interests are quite as likely to create a monopoly as the railway companies. At the meeting of the Association of British Chambers of Commerce on Tuesday, it was shown that there is a tendency among business men to regard the powers asked for by the railways as tending to promote the efficiency of the transport system as a whole.

## The Drought and Water Supply.

AT the last meeting of the Thames Conservancy Board, Lord Desborough dealt with the situation as regards water supply arising out of the low rainfall of the year 1921. The total registered was 12.03in. below the average of the preceding thirty-eight years, and was the lowest on record. The minimum flow of the river at Teddington Weir was not the lowest, owing probably to the fact that for seven successive years up to 1920 the rainfall was very heavy and large quantities were held up in the chalk and porous geological deposits. The situation was, it was intimated, now giving cause for anxiety, and careful surveys of the tributaries of the Thames are being made. These revealed in some instances—the river Lambourn is an example—a heavy fall in the line of saturation. The Thames Conservancy is, it was stated, working in close co-operation with the Water Board, so that the large population dependent on the Thames for water supply may not have to be rationed. Steps are being taken to make all the Thames weirs water-tight, to prevent waste, and it was hinted that it may be necessary to raise the height of the weirs for water storage purposes.

## Rating of Machinery.

AT the luncheon given by the Association of British Chambers of Commerce on Tuesday, Sir Alfred Mond referred to the hardships inflicted on manufacturers by the present methods of rating machinery. He reminded an audience which consisted of business men that there is in England no definite statutory direction on the subject, and this had led to great uncertainty and to practical difficulties with regard to the assessment of premises used for manufacturing purposes and containing machinery, whether fixed to the premises or not. Another objection to present practice is that English and Welsh manufacturers are at a disadvantage as compared with those having premises in Scotland and Ireland. Legislation such as it is desired to promote to obtain relief—which was the chief topic of discussion at the meeting of the Machinery Users' Association on Wednesday—must, n Sir Alfred Mond's opinion, be of a controversial character owing to the fact that if manufacturers obtained relief in respect of the rating of machinery, other classes of the community would have to make up the deficit. He added that the whole subject was receiving his most careful consideration, and had been brought before the Cabinet.

## Cost of Trade Disputes.

WHEN measured by the number of working days lost, the cost to the community of labour disputes is shown to be appalling. The official statement on this subject for last year shows that no less than 80 million working days were squandered by strikes, lock-outs or stoppages arising from disagreement between employers and employed. During last year two million workpeople were involved in disputes having an approximate duration of 27 million working days. The loss to the country should not be counted only in wages, but in the lowering of the efficiency of the whole industrial machine and the opportunity given to foreign competitors to divert custom from British firms. This was particularly the case last year, owing to the grave effects of the coal-mining dispute, and the fact that the aggregate loss of time was in excess of anything hitherto recorded. The changes in rates of wages which took place during 1921, as far as statistics are available, show that there is a net reduction of £6,000,000 in the weekly full-time wages of over 7,000,000 workpeople. For the year 1920 there was a net advance of nearly £5,000,000 in the wages of 7,700,000 workers.

## Dry Docking of H.M.S. Victory.

WHETHER the famous flagship of Nelson has now been towed to her final resting place is not yet known, but there will be no surprise if it is decided to keep her permanently in dry dock No. 2, where she now lies. The vessel will be carefully surveyed, but experts who have had access to the reports made after the earlier examination made when the Victory was at her old moorings in Portsmouth Harbour do not think it will be safe to float the ship again. The greatest care was exercised to ensure that she settled correctly on the blocks, and other precautions taken to avoid any undue straining of the hull. It is an advantage that the dry dock in which the ship now rests is very accessible to the public, being in close proximity to the main gates of the dockyard, and that the dock is not likely to be required for any other purpose.

## New London Telephone Exchange.

THE critics of the Post Office are apt to overlook the fact that within the means at its disposal its Engineering Department has done a great deal of work during a recent period, particularly in the provision of new telephone exchanges and the laying of the underground cable system. It is not generally known that in automatic telephony more has been done by the British Post Office than by any other telephone administration in the world. The latest telephone development is the acquisition of a new site in the City of London for what is intended to be the largest telephone exchange in Europe. It will be a three-unit exchange—each unit making provision for ten thousand subscribers' lines.

## Canalising the Nile.

FRESH attention is being given to the project of canalising those sections of the Nile navigation which prevent through transport by water of goods from Central Africa. The report made on the subject by Sir William Garstin a few years ago put the cost down at about £16,000,000, but a correspondent of the *African World* asserts that canal experts are now agreed that the work could be done for less than half that amount. The Uganda Railway is clearly inadequate to handle the traffic, and consignments sometimes take, it is said, months to reach Mombasa. If the waterway were developed into a through route it would suffice for all requirements. A cheap outlet to the sea from Central Africa is urged as a vital need. The route is already more than half completed. It is possible to-day to travel from Alexandria by rail and river for nearly 1400 miles to Khartoum, and thence by steamer on the Nile another 1100 miles to Rejaf. The completion of the waterway route would, it is urged, justify a far larger expenditure than the most lavish estimate of the actual cost of the engineering works.

## Bradford Canal Abandonment.

AT a time when attempts are being made to induce the Government to find money for waterways improvements, the proposal to allow the Bradford Canal to become derelict is a discouraging incident. The waterway in question is, if not an important canal, certainly, a link in the Yorkshire system, but there are apparently good reasons for the action which the directors of the Leeds and Liverpool Canal Company, who, with the Aire and Calder Navigation, are responsible for the Bradford Canal, propose to take. The loss on working has been an increasing one during the last five years. Less than 150 boats a year have been making the passage of the waterway, and the total tolls received from each boat have been 10s., while the cost of pumping for each barge is said to have been more than £8 10s. If this is the financial situation it is not surprising that the directors of the Leeds and Liverpool Company have been authorised to apply to Parliament for the necessary powers to get rid of this unprofitable waterway.

## The Forthcoming Air Conference.

ARRANGEMENTS have now been completed for the Conference which is to be held at the Guildhall in the first week of February. Although the Service aspect will not be entirely neglected, the Conference will largely concentrate on commercial aerial transport questions. An interesting development is the formation of a Committee of the Federation of British Industries to secure an interchange of views between business men who would be users of aerial transport and designers and constructors of machines. It is felt that the slow progress made by commercial aviation in this country is due partly at least to the want of co-operation between users and those whose business it is to supply the material and operate the services. A determined effort is to be made to develop the carriage of goods by aircraft within the British Isles. The paper which is being read by Major G. H. Scott on "Airships" will enable the whole position as concerns imperial airship services to be reviewed, a necessary proceeding having regard to the activities of the German Zeppelin interests and the declared intention to operate Zeppelin services to the United States, and, by co-operation with Spanish interests, to South America.

## Shipbuilding Wages Conference.

ON what happens at the Carlisle Conference, which opened yesterday, the prospects of a revival in the shipbuilding industry will largely depend. The Conference was convened to discuss the general situation in the shipyards, and also to devise a method by which the war-time bonuses can be discontinued. These cost-of-living advances, amounting to 33s. 6d. a week in all, cannot be borne by an industry that has entered a state of stagnation which is entirely without precedent. Practically no new ships are being ordered, and unemployment has risen to an appalling percentage. In most districts the figure is over 40 per cent. Shipbuilding production costs must be reduced if shipowners are to be induced to order new tonnage. It is said that the cost of wages per hour has increased since 1914 by 105 per cent. in the case of the skilled workers to 176 per cent. for general labourers. The employers' argument is that present rates of wages are not justified by to-day's cost of living, and in any case the industry cannot afford to pay them. A cut in wages is the only method by which an immediate reduction in shipbuilding costs can be achieved, and the means of effecting it is the main business of the Carlisle Conference. It ought to be possible to reach an agreement.

## Reduction of Railway Rates.

INTIMATION has just been received by the Federation of British Industries that the request for another conference with railway managers to discuss the case for a further reduction of railway rates has been granted. Manufacturers all over the country will welcome this news, as the burden of high railway rates is a serious handicap to many industries. The conference will not take place until next month, and this will give time for arrangements to be made to obtain the presence of representatives from all parts of the country and of all the great industries to impress the importance of the question on railway companies.

## An Engineer's Commercial Mission.

IT was a happy thought to entertain Mr. E. W. Petter to dinner on the eve of his departure for India on a commercial mission. The guest of the evening is, of course, the chairman of the British Engineers' Association, and is recognised not only as an excellent representative of the engineering industries, but as a man of affairs, who has done good work in his attempts to solve the difficult problems of the post-war period. Among the guests at the dinner were Colonel Armstrong, the President of the Federation of British Industries, Captain Riall Sankey, the President of the Institution of Mechanical Engineers, and Mr. G. H. Roberts, the joint President of the Industrial League, of the Executive Committee of which Mr. Petter is a member.

## Wages of Railway Shopmen.

IT is hoped that, at the series of meetings which are to be held between the railway companies, the National Union of Railwaymen and the Shipbuilding and Engineering Trades Federation, on wages and conditions of service of men employed in railway engineering workshops, agreement may be reached on a number of points preparatory to arbitration. The Amalgamated Engineering Union—many of the members of which are engaged in railway engineering establishments—are holding aloof on the ground that the N.U.R. Executive has usurped its functions. The present position is that which was reached last summer, when a cut of 6s. per week in wages was accepted, and a decision reached that other matters then in dispute, including overtime, night shifts and district rates of pay, should go to arbitration. The A.E.U. endeavoured to upset this arrangement on the ground that it had not been a party to the proceedings, and, indeed, threatened to call its members out on strike unless its representatives were accorded a separate and independent conference. Having regard to the fact that this Union is refusing to take part in the conference which has now been convened, it may be pointed out that the action it took last year did not meet with the favour of the railwaymen.

## The Electrification of the St. Gothard Railway.

ALTHOUGH we have referred on various occasions, notably in our issue of May 27th of last year, to the electrification of the St. Gothard Railway, the actual equipment of the line has not so far been described in our pages. As everyone knows, the line runs from Lucerne to Chiasso, on the Swiss-Italian frontier. The highest altitude of just under 3800ft. is reached at Goeschenen, which is situated at the northern portal of the great tunnel, which is some 9¼ miles long. Altogether, the line has eighty tunnels, with an aggregate length of about 30 miles, and no fewer than 324 bridges of over 32ft. span. The maximum gradient is 2.6 per cent., or, say, 1 in 38½.

FIG. 1—LAKE RITOM AND ITS DAM

The adoption of electric traction on the line was decided upon in 1913, and, in spite of the unforeseen difficulties which arose in consequence of the war, the work was carried out in a relatively short space of time. In passing, it may be remarked that electrification of other sections of the Swiss Federal Railways is also being undertaken, for the war made it evident that it was of vital importance to provide a form of traction which would derive its energy from a source entirely independent of conditions prevailing in other parts of the world. Whilst Switzerland is forced to import its coal, there is, of course, an abundance of water power, and it is proposed eventually to work the entire railway system by electric traction.

The mountain section of the St. Gothard Railway is already electrically worked, and electrification is being extended to the frontier at Chiasso in the south and to Lucerne and Zurich in the north. Single-phase current at a pressure of 15,000 volts and at a periodicity of 16⅔ cycles is used. There are two generating stations, the Amsteg station on the north side of the tunnel, and the Ritom station on the south side. Both are high head stations, the water for the former being obtained from the river Reuss, and that for the latter from Lake Ritom, which collects water from a great number of streams. The level of the water in this lake, a view of which is shown in Fig. 1, has been raised, so that its storage capacity has been considerably increased.

At the time of writing the Ritom station supplies all the power, for, owing to the severe trade depression and to the fact that up to the present only the mountain section is worked electrically, the load is comparatively light. To facilitate the construction of the pipe line leading the pressure water to the Ritom generating station and the station itself, which is situated at Piotta, a special cable railway was built, and after it had served its original purpose it was converted into a passenger funicular, which is expected to open up a picturesque district that has hitherto been almost unvisited by tourists. A view of a station of this railway and part of the pipe line is shown in Fig. 2, whilst Fig. 3 shows part of the railway and the pipe line under construction. The railway runs from Piotta to Piora, and it is the steepest railway in Switzerland, the average gradient being no less than 71.7 per cent., whilst the maximum gradient is 86.5 per cent. Its total length is 1531 yards. Each of the carriages holds twelve passengers. The speed is 1 m. per second. The permanent way of the funicular railway was laid by Messrs. Maggi and Ramseyer, of Piotta, a firm which was, we believe, created for this special purpose. The machinery, including the cable, was supplied by the Roll Foundry Company, of Berne.

The water for the Amsteg station, which is on the north side of the Alps, is obtained by tapping the river Reuss between Wassen and Gurtmellen, and by conveying it through a tunnel nearly 5 miles long to Amsteg, the tunnel being constructed high up in the side of a hill. The station, the lay-out of which resembles in many ways that of the lake Ritom station at Piotta, had not, at the time of writing, been completed. To a large extent the electrical equipment of the railway has been supplied by the Oerlikon Company. The hydro-electric single-phase generators are designed for an output of 10,000 k.V.A. at a speed of 333⅓ revolutions per minute. The terminal pressure is 15,000 volts, and the periodicity 16⅔ cycles per second. From the view of the rotor, shown in Fig. 4, it will be gathered that the alternators have six poles. All the machines are totally enclosed, and in order that the windings may be adequately ventilated the casings are connected to air ducts. The stators, which are composed of four parts, are designed so that by removing the feet the whole of the frame can be revolved to enable every portion to be inspected. As the armature coils are in semi-enclosed slots, they can readily be removed, but very elaborate precautions have been taken to prevent them being pulled out of the slots during short-circuits. Steel plates having extensions for supporting the pole pieces are forced on to the shafts of the machines so as to form the rotor wheels, and the pole pieces are laminated and provided with damping windings to facilitate parallel operation. Copper strip wound on edge has been used for the field windings. The generator shafts—see Fig. 5—are fitted with forged couplings. Oil is supplied under pressure to the generator bearings by means of a pump, and the temperature of the oil is maintained at the proper level by means of a cooler. Together with its overhung exciter and foundation plate, each generator weighs about 250 tons, the weight of the rotor alone being 100 tons.

FIG. 2—STATION ON THE FUNICULAR RAILWAY

FIG 3—FUNICULAR RAILWAY AND PIPE LINE

For transmission purposes the pressure is raised by means of Oerlikon transformers from 15,000 to 60,000 volts. These transformers, two of which are shown in Fig. 6, are of the oil-immersed type, and the oil is cooled externally in separate tanks. Some of these transformers are rated at 5000 k.V.A., whilst others have a capacity of 10,000 k.V.A. It will be seen from the illustration that the containing tanks, which are composed of steel plate, are mounted on rollers, which can be revolved by gearing operated by hand levers. Each transformer has its own cooling equipment, which is composed of an oil cooler, a pump, pipe connections, gauges and drain cocks. Indicators fitted on the switchboard record the oil and winding temperatures, which can be controlled at will by regulating the flow of the oil and circulating water. To enable the oil in the transformers to be dried and purified with a minimum amount of trouble a portable drying-out equipment is provided. It consists of a small truck which carries a filter and pumps which, when it is necessary to purify the oil, are connected to the oil tanks of the transformers. To remove air and moisture from the oil and windings, a low vacuum is created in the transformer tanks, and whilst the drying process is going on the ordinary covers of the transformers are replaced by more substantial covers. The weight of a 10,000 k.V.A. transformer complete with its oil is about 50 tons.

Although the difference of potential between the high-tension gear and earth is normally 30,000 volts, all the material supplied by the Oerlikon Company for the distribution system is designed for 80,000 volts between conductors and 60,000 volts between the conductors and earth, this factor of safety being deemed advisable on account of the surges that are liable to occur under working conditions. The high-tension gear comprises isolating switches, main oil switches, choking coils, horn type lightning arresters, earthing resistances, insulating supports, and the usual connections, the latter consisting of copper tubes 30 mm. in diameter. All the connections and the high-tension switchgear itself are mounted on conical insulators having separate bases, which are fixed to the insulators by means of a simple clamp, whilst on top of the insulators there are metal caps into which the tube conductors are screwed. The use of cement has been entirely dispensed with. All the live parts of the high-tension gear are nickel-plated and polished. The isolating switches for the bus-bars—see Fig. 8—are mounted on insulators, and are operated from a horizontal spindle by means of a rod composed of insulating material, the spindle being actuated by wire ropes attached to a hand wheel.

As in the event of short-circuits the main oil switches may have to deal with 250,000 kilowatts, they are very liberally proportioned. Each switch—as shown in Fig. 7—consists of two separate four-pole units which are connected in series, so that when the switch is opened each pole of the circuit is broken at four places. The switches are also provided with self-contained protective resistances which, when the circuit is closed, are inserted in two steps. Each of the switch plungers fits into a tubular socket, which is split at the sides so that when the switch is closed a good contact is secured. The switch units are supported on three insulators mounted on a common base fitted with rollers. At the upper ends the plungers are attached to cross arms, which are connected to the operating levers at the top of the switch cubicles by means of insulating rods. Normally the oil switches are operated on the electric remote control system by means of solenoids, and with the aid of an adjustable spring the speed of closing can be adjusted. Only 105 gallons of oil are used for the eight units of each switch. The choking coils—see Fig. 9—consist of flat spiral windings with insulation between the turns. Each spiral, which has a reactance of 0.4 millihenry, is mounted on three separated insulators with separate bases, and each of the outgoing conductors is connected to three of these coils joined in series. For the earth circuits both iron core oil-immersed and air-cooled coreless choking coils are used. The lightning arresters themselves are of the usual horn type. They are mounted on conical insulators, as used for the other high-tension gear, and the gap between the horns can be adjusted between 25 mm. and 125 mm. by moving the horns in their holders. A liquid resistance is connected in series with the arresters. For operating the auxiliaries each of the generating stations is equipped with 500 and 300 volt-ampère transformers, which are connected to the 15,000-volt system and reduce the pressure to 440 volts. A certain number of motor generator sets with capacities ranging from 200 to 100 kilowatts has also been provided for converting

# ST. GOTHARD RAILWAY—ELECTRICAL EQUIPMENT OF RITOM POWER STATION

THE OERLIKON COMPANY, WINTERTHUR, ENGINEERS

(*For description see opposite page.*)

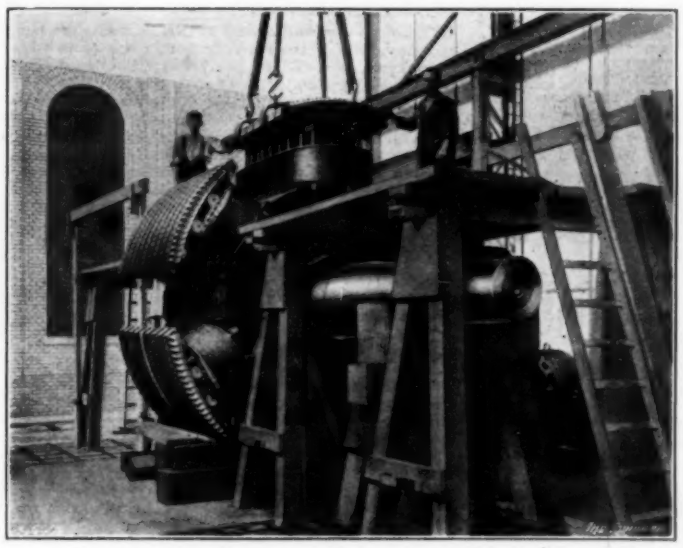


FIG. 4—ROTOR OF 10,000 K.V.A. ELECTRIC GENERATOR

FIG. 5—SHAFT OF 10,000 K.V.A. ELECTRIC GENERATOR

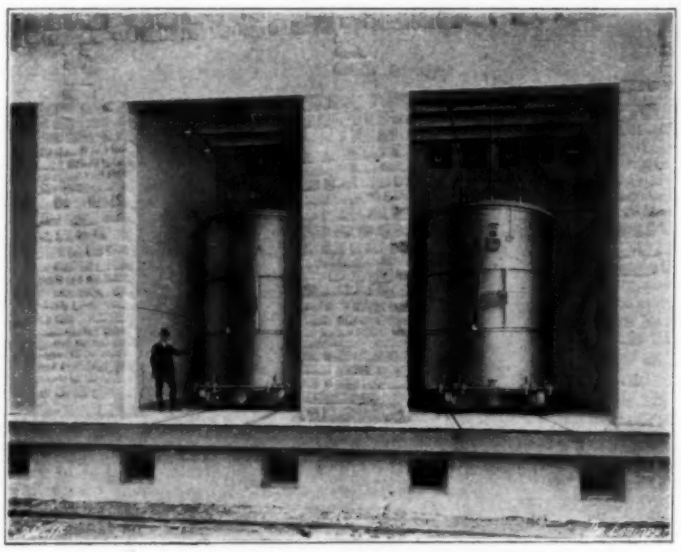


FIG. 6—60,000-VOLT. TRANSFORMERS

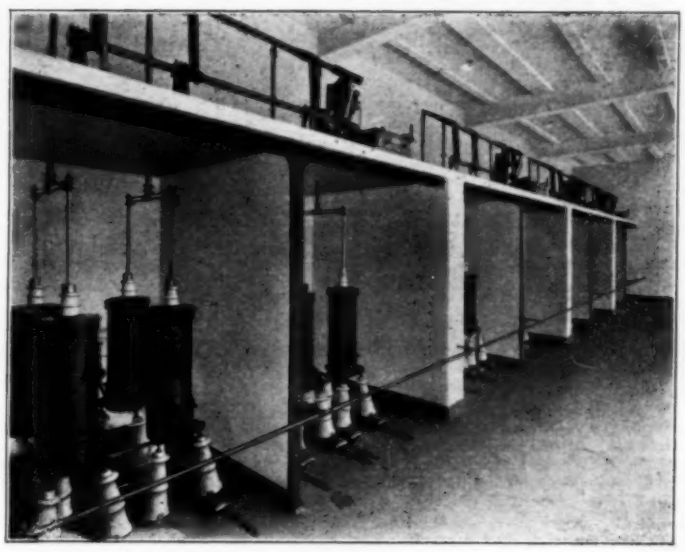


FIG. 7—250,000-K.W. 60,000-VOLT. OIL SWITCHES

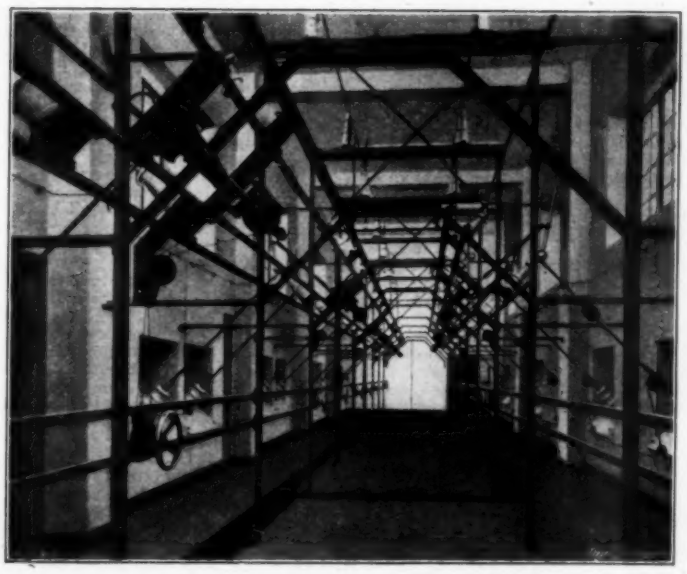


FIG. 8—ISOLATING SWITCHES AND 60,000-VOLT. BUS-BARS

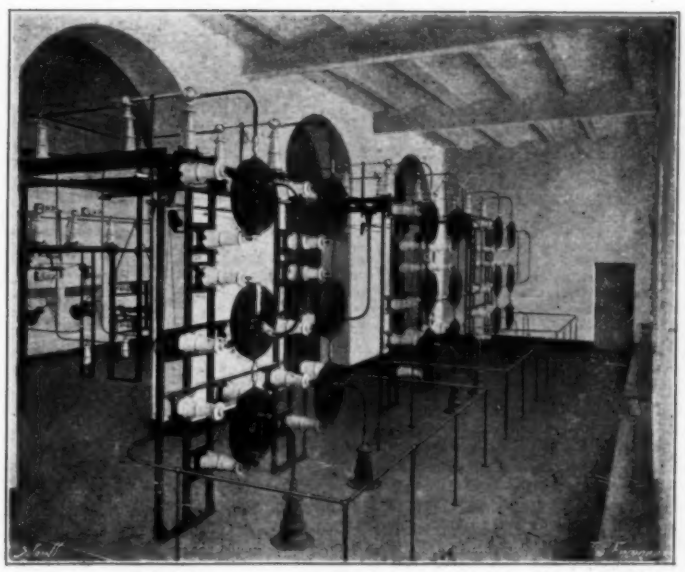


FIG. 9—60,000-VOLT. CHOKING COILS

the alternating current into direct current. These sets are built in accordance with standard practice, but differ from most other machines of a similar kind in that they work at a periodicity of 16⅔ cycles. Views of the Amsteg and Ritom power-houses are shown in Figs. 10 and 11.

The electrically operated cranes in the power-houses are designed to work with 220-volt direct current or 16⅔ cycle 220-volt single-phase current, the motors being Oerlikon series-wound commutator machines. Each of the cranes in the repair shops has a span of 27.6 m.—say 90ft. 6in.—and an actual lifting capacity of 80 tons. They are provided with two hooks, each capable of dealing with 40 tons, and an auxiliary hook which can lift 5 tons. Two of these cranes can lift a locomotive weighing 160 tons. Various types of locomotives have been built for use on the line, and all of them are fitted with regenerative equipment. For express service the Oerlikon Company supplied in the spring of 1919 two engines, as shown in Figs. 12 and 13 on page 72, one being of the 1–C–1 type, and the other the 1–B–B–1 type. Including the time taken in turning at each terminus, both engines will, when the line is fully equipped for electric traction, be able to make, when hauling a 425-ton load, three return journeys between Lucerne and Chiasso in twenty-four hours. On gradients exceeding 2.1 per cent.—say 1 in 47½—a second locomotive of the 1–C–1 type is brought into use. Single locomotives of this type can, however, haul a thirty tons can he hauled by locomotives of this type on gradients of 2.6 per cent. at 35 kiloms. per hour, and 300 tons at 50 kiloms. per hour. With a load of 300 tons a speed of 65 kiloms. per hour can be maintained on gradients of 1 in 100. The leading particulars of these engines are given below.

*Locomotive Characteristics, 1–C–C–1 Type.*

| | |
|---|---|
| Tractive effort at the rim of the driving wheels, developed for 1½ hours, kilos. | 17,000 |
| Maximum tractive effort at starting, kilos. | 24,000 |
| Maximum speed, kiloms. per hour | 65 |
| Length between buffers, metres | 19.4 |
| Total wheel-base of locomotive, metres | 16.5 |
| Total wheel-base of each bogie, metres | 6.7 |
| Fixed wheel-base of each bogie, metres | 4.7 |
| Diameter of driving wheels, millimetres | 1,350 |
| Diameter of pony wheels, millimetres | 930 |
| Diameter of crank circle, millimetres | 600 |
| Reduction ratio of gear wheels | 1 : 4.03 |
| Weight of mechanical portion, including Westinghous brake, tons | 70.6 |
| Weight of the electric equipment, including regenerative braking gear, tons | 56.4 |
| Locomotive attendants and maintenance stores, tons | 1 |
| Total weight of locomotive, tons | 128 |
| Load on axles | 12.0+18.2+4×16.9+18.2+12.0 |
| Adhesive weight, tons | 104 |
| Coefficient of adhesion for tractive effort developed for 1½ hours | 1 : 6.1 |
| Ditto. at starting | 1 : 4.73 to 1 : 4.33 |
| Weight of locomotive per metre run, tons | 6.6 |

The two lower illustrations on page 72—Figs. 14 and 15—show a train on a section of the railway below Wassen and a train near Staverdo, Tessin.

by the works engineer's staff, their speed and feed being controlled by speed and feed experts. Progress of the work through the shops was governed by a planning department, its heating, ventilation and lighting being looked after by the welfare department, and any question of discipline by the employment manager. Piecework or premium prices were set and controlled by timers under the direct supervision of a special department. Any question of dealing with labour or shop conditions was settled in conjunction with the shop committee.

In times past we had looked upon the foreman as being a representative of the management in the shop, whom the workman regarded as being the visible sign of his employer, and it was absolutely necessary that that feeling should continue. In all cases questions of discipline, except as far as punishment was concerned, should be dealt with by the foreman, and he should be consulted before any material change was made in the shop or any alteration in operations. Further, as far as possible, all instructions should be given through him. In fact, everything that could be done should be done to strengthen rather than depreciate his position, whilst at the same time advantage should be taken of the particular knowledge which the special inspectors possessed on various points.

The position of under foremen followed very largely on the same lines. One trouble, however, was with regard to the management keeping in touch with these men. It was a matter of very considerable difficulty, for when in the shop one naturally dealt with the head foreman. Every effort should, however, be made to see the under foremen and encourage them in their work.

The coming of works committees, Sir Henry observed,

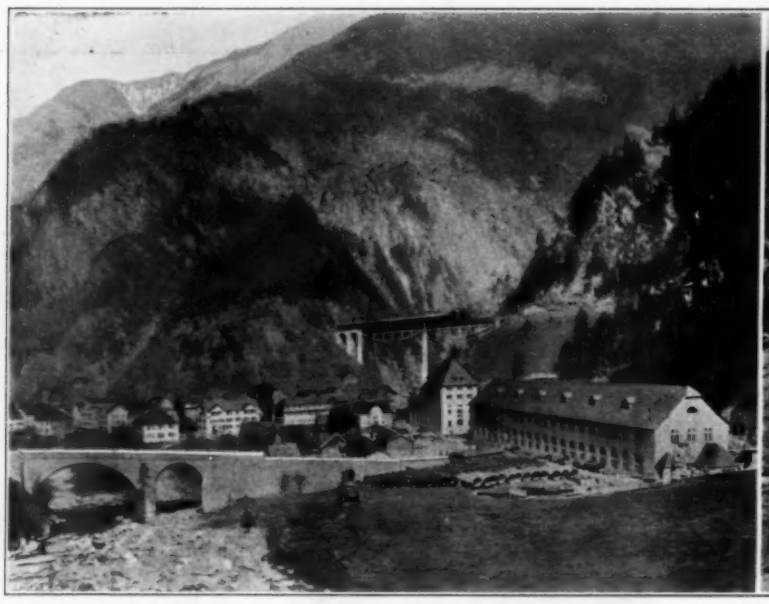


FIG. 10—THE AMSTEG POWER STATION

FIG. 11—THE RITOM POWER STATION

load of 215 tons up an incline 2.6 per cent. at a speed of 50 kiloms. per hour, whilst under similar conditions engines of the 1–B–B–1 type can haul a load of 300 tons at the same speed. At starting under the above conditions the normal speed of 50 kiloms. can be reached with either type of locomotive in considerably less time than was specified, namely, 4 minutes. The following table gives the leading characteristics of these types of engines.

*Locomotive Characteristics.*

| | 1–C–1 type. | 1–B–B–1 type. |
|---|---|---|
| Tractive effort at the rim of the driving wheels for 1½ hours, kilos. | 8,900 | 12,000 |
| Maximum tractive effort, kilos. | 13,500 | 18,000 |
| Speed corresponding to the 1½ hour rating, kiloms. per hour | 50 | 50 |
| Maximum speed, kiloms. per hour | 75 | 75 |
| Diameter of driving wheels, millimetres | 1,350 | 1,350 |
| Diameter of pony wheels, millimetres | 930 | 930 |
| Length between buffers, metres | 13.5 | 16.2 |
| Total wheel base, metres | 10.0 | 13.2 |
| Fixed wheel base, metres | 4.7 | 2.9 |
| Minimum radius of curves on track, metres | 180 | 180 |
| Minimum radius of curves at points, metres | 114 | 114 |
| Weight of electrical equipment, tons | 44.5 | 54.5 |
| Weight of mechanical portion, tons | 46.5 | 58.5 |
| Total weight of locomotive, tons | 91 | 113 |
| Load on axles | 16.25+3×19.5+16.25 | 16.5+4×20+16.5 |
| Adhesive weight, tons | 58.5 | 80 |
| Coefficient of adhesion for tractive effort developed for 1½ hours | 1 : 6.6 | 1 : 6.7 |
| Ditto at starting | 1 : 4.3 | 1 : 4.4 |
| Weight per metre, tons | 6.75 | 7 |

In March, 1918, the Oerlikon Company received an order for the supply of the electrical equipment of ten 1–C–C–1 type locomotives for goods service, whilst during 1919–20 further orders were received for the equipments for twenty-three additional locomotives. These engines can make two journeys between Goldau and Chiasso in twenty-four hours, including a stop of 15 minutes at each of the terminal stations, and when hauling a load of 860 tons. On gradients exceeding 1 per cent., a second locomotive is used at the rear of the train. Four hundred and

## Manchester Association of Engineers

THERE was a very large attendance of members of the Manchester Association of Engineers at a meeting on Friday last to hear Sir Henry Fowler read his paper on "Shop Management," a better title for which would probably be "The Training, Selection and Status of an Engineering Foreman." Sir Henry prefaced his remarks by saying that probably the greatest change which had taken place in connection with workshop management was that in the position of the shop foreman. In times past the foreman was undoubtedly to a very large extent manager, whose particular business it was to control in every way the work that went on in the shop. He had the right of engaging, and discharging all the men who were in the shop, fixing all piecework prices or payments by results, the ordering and receiving of material of all classes, and, to a great extent, the rates of pay to the various men under his control.

The position, Sir Henry said, had naturally of recent years changed very materially. The first point, probably, which led to a change was the standardisation of wages, which took not only out of the foreman's hands but also out of the hands of any one management, the question of the amounts to be paid to the various employees—the rates now being on a district basis. It was probable that in some shops and some works in which the shops were not of any size, and the chief work carried out was that of repair, and in which even the class of article required varied from day to day, the foreman still exercised, with the exception of the wages question, most of the authority which had been mentioned above.

At the other end of the scale were shops of considerable size where a single article only was made; and, in certain cases, where only certain portions of that article, perhaps, were manufactured. In such works entirely different conditions prevailed. Men were engaged by the employment manager and allocated by him to the shops. The materials were ordered and allocated to the shops by the order office. Machines for carrying out the operations were purchased after collaboration between the drawing-office and the works engineer, and were fixed in the shop had made a considerable change in the relation between the foreman and the men under him. In cases in which these committees were of a formal nature, the foremen must be represented when discussions took place on subjects pertaining to their own shops. They must be made to appreciate that the discussions were on and along broad lines, and must feel that the shop committees had not been established in any way with a view of their being derogatory to their prerogative.

The discussion which followed the reading of the paper turned almost entirely round the foreman, his status and his remuneration. Mr. Pilling, who opened the debate, suggested that a foreman's wage should be substantially higher than the average day work pay in his department, with a bonus on the work turned out. Mr. Bailey referred to the foremen as "the backbone of the works." He described the system of training assistant foremen which is common in America. In the course of training, he said, the following subjects were taken:—Draughtsmanship, production, testing, inspection and "processing," or planning, after which the assistant foreman was attached to one of the senior general foremen. He recommended the formation of foremen's associations for the improvement of knowledge by visiting works and the reading and discussion of papers. As regarded payment, Mr. Bailey said that some form of bonus system was essential. Mr. Chaplin advocated the desirability of foremen engaging their men and maintaining discipline, but punishment he said, should be administered by others. He urged that, in cases of dispute, the workman should have a chance to state his own case to the management. He also advocated foremen attending the periodical meetings of the works committees. Mr. Bissett recommended that the foreman should have a free hand with regard to the engaging and dismissal of his men. He said that this system worked well in Lancashire towns in which the workers were not migratory, and were therefore well known to the foremen, who could select them better than could labour bureaus. He recommended a higher rate of pay for foremen than for the workers. Mr. Cooke followed in a like strain. Mr. Hanson said that the essential qualifications for a good foreman were initiative and craftsmanship, and remarked that after selecting a young man for training for a foreman's post he would first put him on a "marking off" table; then transfer him to the inspection department. After he had gained a thorough knowledge of these branches he would be qualified for an under-foremanship, and would graduate upwards.

## Railway Matters.

THE Norwegian National Engineers' Association has appointed a Committee to report as to whether the time has now come for all the railways in the country to be electrified, and whether the plans for projected railways should be drawn up on the basis of electrification.

WE mentioned in this column on December 9th how the London and North-Western carriage shops at Wolverton were on short time. It is pleasing now to be able to report that the coach painters are again on full time, and it is expected that the upholsterers and other workers will soon be in the same position.

SPEAKING recently at the annual meeting of the Irish Railway Stockholders' Protection Association the chairman said that it ought to remain in existence. He felt sure that under the rule of the Irish Free State the Government department controlling transport would need all the support and guidance the Association could give it.

THE National Wages Board, under the presidency of Sir William Mackenzie, which is inquiring into the claim of the Scottish railway companies to alter the award of May, 1920, and to modify the eight-hour day, is still hearing the railway companies' case, having sat continuously, except on Sunday, since Wednesday, the 11th.

THE Japanese and Chinese delegates at Washington agreed, on the 12th inst., on details for the construction of three extensions of the Tsingtao-Tsinanfu Railway in the Kiaochow leasehold. Two extensions, the Tsinanfu-Shunteh and the Kaomih-Suchow-Fu, will be built by an international group, probably the existing Consortium, while the Chefoo-Weishei extension will be constructed by China. An attempt is now being made to agree on the question of opening the port of Tsingtao to all commerce on equal terms.

THE U.S.A. Government railway in Alaska was opened throughout to Fairbanks on November 26th. A total of 545 miles is now in operation, with a train service twice a week in each direction. At two river crossings, temporary arrangements are still used. At mile 347 a steel viaduct is to be constructed, the steel for which has been shipped and it is expected to have the bridge erected by February 1st. This will complete the line with the exception of a permanent crossing of the Tanana River at Nenana, about 35 miles from Fairbanks for which an appropriation has been made by Congress. The crossing is now made by ferry in the summer, and by a railway over the ice in winter.

EXTRACTS A, B, C, D and E of the annual reports of railway companies give particulars (A) of the maintenance and renewal of way and works and (B) of locomotives, carriages and wagons, (C) of the locomotive running expenses, (D) of the traffic expenses and (E) of the general charges. Unlike other accounts in the report they were not affected by the cessation of the division of receipts owing to the control of the railways. But, in order to economise in clerical labour, they were omitted from the reports during, and subsequent to, the war. From some correspondence recently published in the *Manchester Guardian* it appears that these abstracts will not appear in the forthcoming reports for 1921.

THE Great Western Railway Company has recently taken a leaf out of the book of many American railroads It has issued a circular to each of its staff of 90,000 appealing for individual economy and pointing out that if each servant would save sixpence a week there would be an annual saving of £100,000. The circular asks:—"Do you realise that a shunting pole costs 4s., a wagon sheet 100s., a guard's hand lamp 17s., a platform broom 4s., a packers' shovel 4s.?" As an example of possible economies it is observed that every time a wagon sheet tie is thoughtlessly cut, instead of being untied, it costs a halfpenny for replacement. A small sum in itself, but applied all over the line it becomes a heavy item of expense. Last year the company spent over £7500 in sheet cord alone.

THERE have been two awards by Mr. Carrigan, K.C., the independent chairman of the Irish Railways arbitration Board; one related to wages, and the other to a modification of the eight-hour day. Both were to have gone into effect on Sunday last, in which event the men threatened to come out on strike. Efforts were made by the Dail Eireann to postpone the strike but unsuccessfully, and the National Union of Railwaymen said on Friday that the strike would definitely take place and that the stoppage would be complete throughout Ireland. The meeting of the Southern Parliament on Saturday and the acceptance of the Peace Treaty brought influence for good to bear, with the result that on Saturady evening, at a meeting between the railway managers and the men, brought about by the mediation of the Minister of Labour, it was agreed to put the wages award into operation forthwith, but to postpone the change of hours for a month to allow the Provisional Government to investigate the dispute.

ON September 30th last, the engine of a passenger train from Newcastle to South Shields, North-Eastern Railway, was derailed at Hilda Junction, between Tyne Dock and High Shields stations. The engine, which was travelling tender first, was one of the older type of 0–6–0 engines, with a six-wheeled tender which was fitted with overhung laminated springs. After the derailment the left-hand leading spring of the tender was found on the ground alongside, the top leaf being fractured about 7in. from one end. The upper, or cup-headed portion, with its set screw, and the lock nut of one of the links was missing. The lower portion was attached to the tender frame, and the coupling nut was found 150 yards in the rear of the first marks of derailment. The argument of the railway company was that the derailment was primarily due to the fracture of the top plate. It was suggested that the fracture took place some considerable distance away, and that the tender had been running with the broken spring for some time. Major Mount, who inquired into the accident, was, however, of the opinion that the lock nut on the link became loose and the coupling nut gradually worked off. The spring thus became inoperative. He thought that the top plate of the spring was broken as a result of the derailment.

## Notes and Memoranda.

THE iron mines at Kiulingchen, some four miles from the Shangtung Railway in China, are estimated to contain about 100,000,000 tons of ore. The greater part of the deposit is said to be magnetite containing 63.58 per cent. of Fe, while the remainder is hematite of 56 per cent. Fe.

ACCORDING to some figures given in a paper on "Thermal Sanitation in the Tropics," by Mr. G. W. Grabham, and contributed to the *Journal of Hygiene*, the temperature inside a brick exposed to brilliant sunlight in the Sudan was 57.8 deg. Cent. in the case of a plain burnt brick, 54.3 deg. for a sun-dried brick, 49.5 deg. for a whitewashed mud brick, and 48.3 deg. for a whitewashed burnt brick.

A NUMBER of investigations in recent years have indicated that sintered or coherent zirconium metal is very resistive to acids, that it can be used for electrodes, and it probably will find metallurgical uses. A steel containing zirconium has been proposed for use in armour plate and motor car parts, and nickel-zirconium alloys have been suggested for high-speed cutting tools and for cutlery.

IN a short article on the froth flotation process for cleaning coal, in the *Iron and Coal Trades Review*, Mr. E. Bury says that it may be taken as established that, where the non-coking properties of a coal are due to the presence of fusain, the fusain can be removed, leaving an excellent coking product. This discovery marks a new stage of development in the preparation of metallurgical fuels. Many iron ores are at present unexploited owing to a dearth of coking coal, and the differential method may well lead to far-reaching economic developments in those countries at the moment industrially impotent in so far as concerns coking coal.

THE *British and South African Export Gazette* states that the removal of supply restrictions has given an immediate impetus to the local market for fittings, cooking, and heating apparatus, &c. Contrary to the general impression, the bulk of the electrical plant of this type sold in South Africa is of British, and not American, manufacture, and although a certain amount of German competition is being felt, the British article is preferred even if the price is slightly higher. Taking the Union's trade in electrical material and machinery as a whole, it is very significant that, unlike many lines, purchases last year were greatly in excess of those in 1920, the business in cooking and heating apparatus alone being worth £35,692 in the first nine months of 1921, as compared with £28,195 for the same period in 1920.

THE demand for improved lighting in mines has caused a great increase in the number of electric safety lamps. The total employed in 1920 was 245,900, compared with 197,722 in 1919. In the Yorkshire and North Midlands division there are 107,111 electric lamps, in South Wales 94,358, and good progress is also being made in the other mining areas. The magnetic method of locking is employed for 228,459 electric lamps, against 181,925 in 1919, and the lead rivet for 17,342, against 15,689. There was a drop in the flame safety lamps from 636,158 to 635,127, but lighting by electricity was used for 422,167, against 418,344 safety lamps in the previous year. These figures are significant of the progress of electricity in all branches of mining work, and we have no doubt that as the mining industry becomes more normal the progress will be still more rapid.

A NEW type of steel which is highly susceptible to the acquisition and retention of magnetic properties, has been discovered, according to *Chemical and Metallurgical Engineering*, by a Japanese. It has the composition: carbon, 0.4 to 0.8 per cent.; cobalt, 30 to 40 per cent.; chromium, 1.5 to 3 per cent.; tungsten, 5 to 9 per cent. It is very brittle and very hard, and great care has to be exercised in its manufacture. Its coercive range is about three times that of the best tungsten steel; the area of the hysteresis curve is also three times as great; the permanent magnetism is relatively very high; lastly, shocks and prolonged heating have a negligible effect on the magnetisation. In shock tests, a slight diminution in permanent magnetism was observed—6 per cent. after 850 impacts by dropping from a height of 1 metre on to a cement floor.

IN estimating the washability of a coal the organic sulphur content is, according to a report in the University of Illinois *Bulletin*, an important consideration. The chief value in experimental coal washing of the determination of this constituent lies in finding a value below which there can be no reduction of sulphur content by mechanical processes of separation, since the organic sulphur content of coal is not reduced by such methods. Furthermore in all coals a part of the pyritic sulphur will remain in the washed coal, the amount depending upon the physical form in which the pyrite occurs in that particular coal. Thus in every case the minimum sulphur content that may be obtained in the clean coal is well above the organic sulphur content. All of the pyritic sulphur occurring in the form of microscopic pyrite, and a large part of that included under the classification of "fine disseminated pyrite," is not removable, and for practical purposes in connection with coal washing may be considered as "fixed" sulphur.

IN the course of a paper read before the Institution of Engineers and Shipbuilders in Scotland, Mr. W. Rees Darling described a form of gear which he proposes for marine propulsion. The place of the teeth on the pinion is taken by a bundle of loose wire rollers, which are free to move and adapt themselves to the form of the teeth on the gear wheel. The author said that "there remains but the question of efficiency or economy of power, and, at the moment, I am unable to give any figures. The pinions in use so far have been fitted for the purpose of surmounting difficulties which had previously seemed insuperable, and have proved entirely successful. In some cases it was required to engage and disengage the gears frequently while the machine was running, and this could not be done by sliding the teeth into mesh. Pinions of the new type may be moved into gear instantaneously or gradually while revolving at any speed. This is done regularly at present at a speed of 2000 revolutions per minute without shock or danger of any kind. This fact appears to indicate adaptability, elasticity, and efficiency."

## Miscellanea.

IT is reported that some success has attended the efforts of Messrs. Thyssen, of Mullheim, in the development of the oil turbine, by using specially treated electric-steel blades.

THE Chinese Maritime Customs at Tientsin has made it possible for all steamers sailing to the northern port during the winter to go direct instead of around Zing Waung Tao to Tai Koo Kao, by installing ice-breakers. A toll is charged each steamer.

BY a Canadian Order in Council the operation of the Marking Act, under which imported goods are required to be marked with the name of the country of origin, has been suspended until after the next session of Parliament. It is expected that the Act will be repealed in the interval.

THE tonnage of vessels entered with cargoes at ports in British India from foreign countries and British Possessions during the month of November, 1921, amounted to 730,000 as against 641,000 in October, 1921, and 586,000 in the corresponding month of last year. The tonnage of vessels cleared with cargoes was 486,000 in November, 1921, compared with 494,000 in the preceding month and 460,000 in November, 1920.

IT is learnt from Brussels that a meeting held for the purpose of considering the reconstitution of the Comptoir des Acieries Belges has not yielded any definite results. Yesterday (January 19th) a semi-official meeting was to have been held at Paris for the conclusion of an agreement between the French and Belgian iron and steel manufacturers, to be followed by an official meeting to discuss an inter-allied metallurgical *entente*.

WE are informed that the Watford Engineering Works, Limited, paper mill engineers, last month distributed amongst the employees the amounts earned in the second year's working of the profit-sharing scheme. Despite the somewhat diminished trade during the year, the distribution worked out at approximately 4½ per cent. on the wages, although the number of workers benefiting had increased by 22.4 per cent. as compared with the previous year. The directors are satisfied that the plan has proved beneficial, and the increased number of workers entering the scheme testifies to the appreciation of the men, both union and non-union.

THE Tunnel Commissions of New York and New Jersey began to advertise at the end of last year for tenders for the construction of the vehicular tunnel under the Hudson River. The cost of the tunnel, which is estimated at 28 million dols., is to be borne equally by the two States. The work is to be completed in three years. Each of the two tubes will have a 20ft. roadway, and there will also be a footway in each tube. The two separate tubes, which will be built close to each other, will be connected at intervals with cross passages for pedestrians. It is stated that the twin tubes will provide for the passage of 48,000 vehicles a day or twice the traffic crossing the Hudson River.

THE White Star Line has decided to create the appointment of a commodore to their fleet, and the first commander to hoist the flag—a red pennant with a white star upon it—will be Sir Bertram Hayes, K.C.M.G., D.S.O., R.D., R.N.R., who was recently promoted to similar rank in the Royal Naval Reserve. The commodore's colours will be flown over the Line's house flag. Sir Bertram, who is at present in command of the Olympic, has been appointed to the Majestic, 56,000 tons, the largest steamer in the world, which is scheduled to leave Southampton on May 10th on her maiden trip in the White Star Line's Southampton-Cherbourg-New York service, when he will hoist his pennant for the first time.

BIRMINGHAM possesses nine glass furnaces, and, according to the *Birmingham Post*, the present rate of production is not up to half capacity owing to the impossibility of making effective response to the foreigners' challenge with regard to lighting wares, chemical glass, and some other lines. In the Stourbridge district business is unequally distributed. One firm has had to run extra shifts to get out its orders for table glass, but elsewhere there is a good deal of slackness. The optical glass industry at Smethwick is again suffering in much the same way as it did before the war suddenly made such imperative demands for its expansion. We spent over four millions on foreign glass during the eleven months ended November, while our exports realised two millions.

THE official trials of the geared turbine steamer Gouverneur General Chanzy, which has been built by Cammell, Laird and Co., Limited, of Birkenhead, for the Marine Marchande, were recently carried out successfully on the Clyde under the supervision of Monsieur Bourges and Monsieur Le Mignon, representing the French Government. They consisted of a four-hours full power trial and a twelve-hours coal consumption trial. The full power trial was run on the 12th January, and a speed of 19.559 knots was obtained over the whole of the four hours, this being in excess of the contract by 0.559 knot. A twelve-hours coal consumption trial at 17½ knots was run on the way back to Birkenhead, that speed being obtained on what is described as being a remarkably low consumption. The vessel is intended for service between Marseilles and Algiers.

THREE nations, France, Italy and England, will be represented in the French Grand Prix automobile race, to be run on July 15th over a short course near Strasbourg, for a distance of about 500 miles. The French representatives will be:—Rolland-Pilain, three cars; Delage, two cars; Bugatti, four; Mathis, one; and Slim, one. Italy will be represented by a team of three cars. England will send three Sunbeams and two Aston-Martins. Total, nineteen cars. This year's race is for cars having a piston displacement of not more than 2 litres, or 122 cubic inches, that being the smallest size ever adopted by the French club for its annual road race. This size approximates to the piston displacement of the average 12 horse-power touring car, but the racers are expected to attain a maximum speed of more than one hundred miles an hour. On the day following the 2-litre race there will be a second speed contest for four-seater cars which must average 16.6 miles to the imperial gallon. Sixteen French cars are entered in this event.

(For description see page 68)

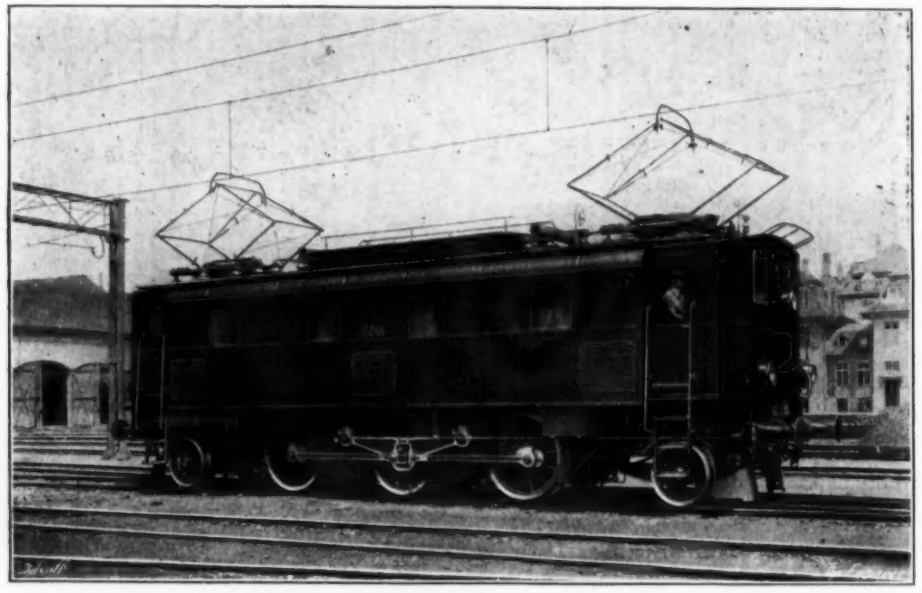


FIG. 12—I-C-I TYPE ELECTRIC LOCOMOTIVE

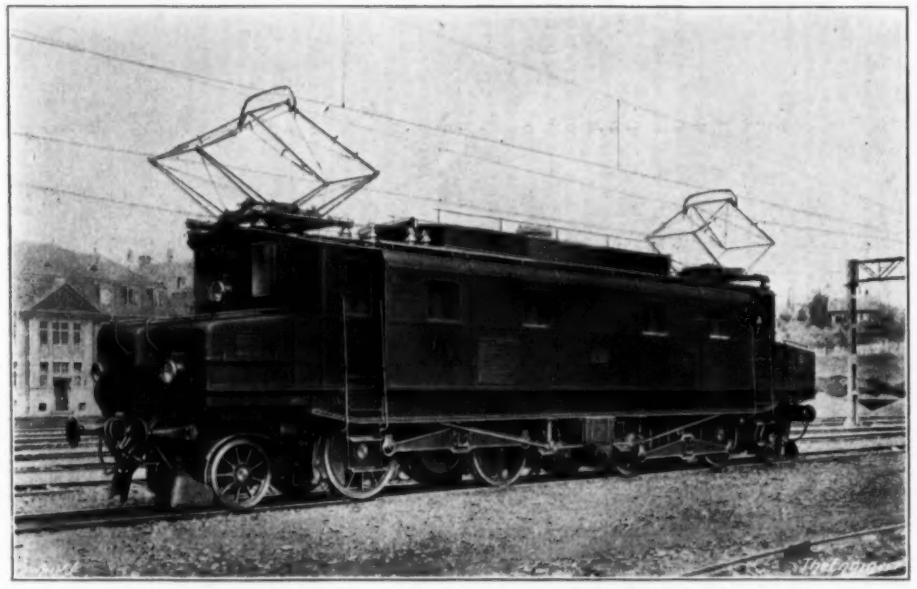


FIG. 13—I-B-B-I TYPE ELECTRIC LOCOMOTIVE

FIG. 14—A TRAIN ON A SECTION OF THE RAILWAY BELOW WASSEN

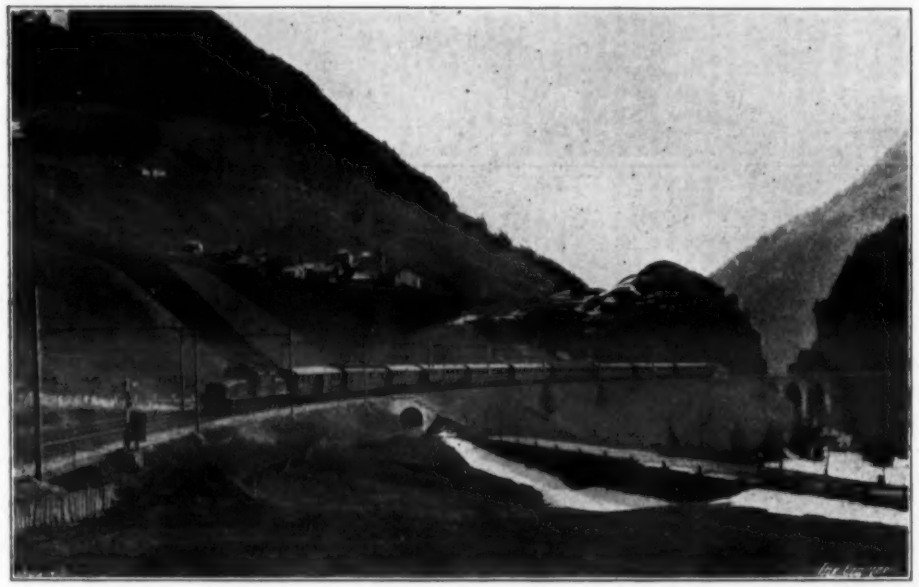


FIG. 15—A TRAIN NEAR STAVERDO TERSIN

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# THE ENGINEER.

*JANUARY* 20, 1922.

### The Vacuum Airship.

ALTHOUGH the airship in this country is for the time being virtually dead, activity in connection with it is still being displayed in several foreign quarters. There are, of course, some here who even yet have not abandoned their faith in its future, but it cannot be denied that very little impetus now remains in this country behind the development of airships. They have been virtually discarded for naval and military purposes; those which we own have been the subjects of frequent mishaps, culminating in the lamentable disaster to R 38, and all efforts on the part of the Government to induce anyone to take over and operate the existing fleet on a commercial basis have failed. Abroad the discouraging factors have apparently been less acute or less acutely felt. Certain it is that here and there people are to be found who are labouring undauntedly to improve the design and construction of airships. In the United States, for example, full-sized experiments are being conducted by the Navy Department on the use of helium or a helium mixture as a substitute for hydrogen. But of all the efforts now being made none exceeds in scientific interest and fundamental significance those in connection with the Vaugean airship at present in course of construction at Milan. This vessel, of which a description was published recently in *Le Génie Civil*, does not derive its buoyancy either from hydrogen or helium. Instead, M. Vaugean seeks to secure flotation by exhausting the air from a metal-sheathed envelope. Such a proposal is, of course, far from being new. Indeed, the use of rarified air as represented by Montgolfier's fire balloon of 1783 actually takes precedence of hydrogen or coal gas in point of time. It has, too, so far failed to yield practical results of any importance, and in modern times has been shown mathematically to be impossible of application to airships of the self-propelled type. M. Vaugean holds, however, that the mathematicians' conclusions are premature, and that recent metallurgical discoveries combined with the adoption of certain principles of construction and working which he has devised, bring the proposal inside the reach of practical attainment.

The rock on which the vacuous balloon or airship has hitherto foundered is the difficulty or impossibility of constructing the envelope of sufficient size to give the required lift and of sufficient strength to resist the air pressure. A cubic foot of air weighs just over fourteen times as much as a cubic foot of hydrogen at the same temperature and pressure. It therefore follows that a given volume filled with hydrogen at atmospheric pressure is equivalent in lift to the same volume exhausted of air to a pressure very slightly in excess of one pound per square inch absolute. The outer skin of the equivalent vacuous airship or balloon is thus exposed at the ground level to a resultant pressure of 13.7 lb. per sq. in., a figure small, of course, when contrasted with the pressure inside a boiler or outside a tube, but of prohibitive magnitude when applied to the exterior of a vessel of the size and construction of an airship or balloon. The essential characteristic of M. Vaugean's scheme is that he does not propose to employ such a degree of rarefaction *at the ground level*. He designs his airship to travel, let us say, at an altitude of 10,000ft. At that height the atmospheric pressure is about 10 lb., so that with an internal vacuum of 1 lb. absolute the envelope will be subjected to a resultant pressure of 9 lb. per square inch, a value which, he believes, he can design it to withstand. To descend he increases the internal pressure in such a way that when the ground level is reached it amounts to 5.7 lb.—that is to say, in such a way that the resultant pressure on the exterior of the envelope remains constant at 9 lb. throughout the descent. It is to be noted that were the internal pressure not increased and were the vessel pulled down to the ground level by means of ropes, it would arrive at the surface with a considerable amount of surplus lift. By increasing the internal pressure in the manner stated the lift remains constantly equal to the weight of the structure throughout the descent. Such, in brief, is the essence of M. Vaugean's scheme. As for practical details, it will perhaps be sufficient to say that it is proposed to use aluminium - copper - manganese alloys for the structure and sheathing of the envelope, to maintain and vary the internal vacuum by means of pumps assisted by the heat of the exhaust from the engines, and to carry the vacuum in three or more concentric chambers, each, passing inwards, containing a higher degree of rarefaction than the next outer one. By the judicious choice of the temperatures at which the contents of the three concentric chambers are preserved M. Vaugean estimates that it will be possible to operate the vessel with an effective pressure of only 2.1 lb. per square inch on the outer skin, 3.5 lb. on the intermediate, and 4.5 lb. on the inner.

The scheme is doubtlessly open to criticism at several points. For instance, it appears certain that it is bound to result in an increase in the dimensions of an airship designed to give a specified lift. That such will be the case can readily be shown for the vacuous airship without concentric chambers. Taking the internal pressure at the ground level at the value previously mentioned—namely, 5.7 lb.—a simple calculation shows that to develop the same lift as a hydrogen airship the vacuous vessel would have to be 1.55 times as great. Such a magnification of the dimensions of a type of vessel already objectionably large cannot be regarded with approval, but it is not of itself a fatal disadvantage. From the practical rather than the theoretical point of view criticism of the scheme will no doubt be chiefly directed towards the difficulty of creating and maintaining a high degree of vacuum in a vessel the capacity of which may be anything from one to three million cubic feet. The effort required to maintain a good vacuum in a condenser is well known, but the two cases are, we think, hardly comparable, although we feel certain that this question of maintaining the vacuum will be quite the most difficult that M. Vaugean will have to face. It should be remembered, however, that by carrying the vacuum in three or more concentric chambers differentially exhausted, not only is the crushing stress reduced, but the tendency to lose the vacuum by leakage is favourably modified. In addition, the arrangement will no doubt help the vessel in the matter of the size of the exhausting plant to be carried on board, for operational changes of the internal pressure would no doubt be effected in but one of the chambers, leaving the others under the pre-arranged vacuum. The whole scheme is very highly interesting. It may not be completely practicable at the present moment, but it might well become so with a little experience or, at the worst, as a result of some apparently small advance in metallurgy or in some other direction. It is at any rate worthy of scientific attention, for if it is or becomes practicable it will do very much more for the airship than would the discovery of a cheap, plentiful and handy source of helium or other light non-inflammable gas.

### Railway Signals.

IT was in 1841 that Charles Hutton Gregory adapted the semaphore, used in telegraphy, as a substitute for the disc signals up till then used

for controlling the movement of trains. It was the first important development in railway signalling and remained so until Saxby introduced interlocking in 1856, and Livesey, Edwards and Jeffreys patented the facing point locking bar in 1867. Thus, for eighty out of the nearly one hundred years railways have been in existence, the semaphore has been the main instrument for regulating the running of trains. Its place, however, is now threatened. Towards the end of last July the Ministry of Transport appointed a Departmental Committee to consider the potentialities of light signals, *i.e.*, signal indications given by means of red, yellow or green lights only. Signals of this character were brought into use last autumn on the Liverpool Overhead Railway, a description of which installation appeared in our issue of November 11th. Previously to their use in Liverpool light signals were, as far as this country was concerned, to be found only on the Underground Railways of London. In Liverpool, however, they are employed for giving indications in the open, by day as well as by night. We would explain, before going further, that the class of signal now under discussion must not be confused with the type used in tunnels, where a frame carrying red and green spectacle glasses is raised and lowered to give "clear" and "danger" indications. Light signals, as now understood, have no moving parts; they have red and green lenses—in some cases red, yellow and green—behind which are electric bulbs, only one of which can be alight at the same time. This type of signal was first used in the signalling of the New York Subway in 1904 and was introduced into this country when the Central London Railway was re-signalled in 1914. Its use in the open, as a daylight colour light signal, was mainly developed on the Chicago, Milwaukee and St. Paul electrification scheme, when it was found that the poles, arms and wires of the power lines obstructed the drivers' view of semaphore arms. So successful was this type of signal—known as the colour light—which is now in use throughout the whole of the 886 miles of electrified line on the Chicago, Milwaukee and St. Paul, that it has been adopted over the whole of the United States. The reason for the designation "colour light" is that there is another class of light signal—the position light, in which system there are three rows of white lights to correspond with the horizontal, inclined and vertical indications of a three-position signal. As in the colour light, only one indication can be given at the same time. This system was installed in 1915 on the Philadelphia-Paoli section of the Pennsylvania; but, whilst its use is now somewhat extensive on that system, it has not been adopted elsewhere. The objections to the position light signal, which have probably led to its want of popularity, were stated in our description of the signalling of the Liverpool Overhead Railway.

The report of the Committee appointed in July last was issued on the 11th instant. The members visited the Liverpool Overhead Railway, where the signals were seen during brilliant sunshine and when the sun was immediately behind and also in front of the signals, and it was noted that signals over 1000 yards distant were distinctly visible in these conditions. After expressing the opinion that the colour light signal offers marked advantages over the position light, the report says that the Committee is also of opinion that the colour light could be arranged to meet, as far as can be seen, all conditions now covered by the existing semaphore type. The question of cost of installation and maintenance is considered, and it is stated that light signals in busy areas will cost less than semaphores, and that for sparsely signalled sections their advantages can be obtained with little difference in cost. There will also be economies arising from the fact that the lamp cases containing the signal mechanism occupy less space, are of less weight, and are less exposed to wind pressure than a semaphore arm. There will be all the advantages of a power-operated signal—accurate working, ease of operation, and no signal wires to adjust for variations in temperature. Moreover, light signals can be better seen in fog than semaphores. Several recommendations as to what should be done and what be employed, most of which have evidently been based on the experience gained in Liverpool, are made in the report.

Having had the privilege of inspecting the Liverpool Overhead installation in considerable detail, we feel justified in supporting the views advanced by the Committee. We would, however, have liked expression to have been given to an obvious disadvantage that would arise from the elimination of the semaphore and its substitution by light signals. Only last week, in a leading article on "Accidents to Platelayers," we drew attention to the fact that in 1920 there were 310 accidents to permanent way men, of which 33.9 per cent. were fatal, and that there were 80 accidents to men walking and standing on the line on duty elsewhere than at stations, of which accidents 53.7 per cent. were fatal. In addition to these there were 137 accidents, 46 per cent. of which were fatal, to men while working on the permanent way, and 217, of which 32.7 per cent. were fatal, to men while walking or standing on the line on duty at stations. Most men, when on the track, keep their eyes on the signals, if there be any near, in order to be warned of the approach of trains. But when semaphore arms are abolished only those light signals which are in advance of the men can warn them.

### The Corrugation of Rails.

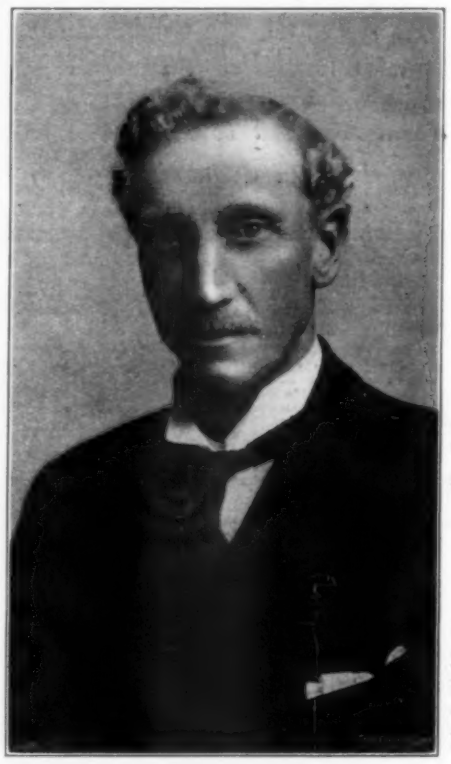
THE report presented by the Rail Corrugation Sub-committee to the Municipal Tramways Association, of which we give a short summary elsewhere in this issue, seems to lay at rest the cause of "corrugations" in rails. After a prolonged period of observation under particularly favourable circumstances, it has been concluded that vibration of the rails or their foundations has little or nothing to do with the matter, as some held it to have, and that the real cause is to be traced to the generation by the moving load of stresses on the surface of the rails in excess of the elastic limit of the material. The evaluation of the pressure produced by a loaded wheel rolling on a rail is very far from being an easy undertaking, for we must always have some doubts as to the exact load on the rail when the wheel is moving even although the static load is known with exactitude. The force of impact may in fact raise the actual load supported by the rail to twice the static load on the wheel. More difficult still is it to say over what area this load is supported. The contact between the wheel and rail is of course far from being the lineal one assumed in elementary text-books. There is a definite area supporting the load, for neither the rail nor the wheel is composed of completely rigid material. Finally, even supposing that the true load and the exact area supporting it were definitely known, we should still be able only to calculate the average stress over the area of contact. At the periphery of the area the stress must obviously fall to zero—at least when the wheel is stationary—and therefore at the centre we may expect that it rises to something like twice the average. Efforts have been made to determine mathematically the distribution of stress over the area of contact between the tire and rail, but although formulæ have been arrived at, they are, we think, to be distrusted on the ground that the slightest departure from true mathematical circularity in the wheel or from true mathematical straightness in the rail will produce a great alteration in the stress distribution. Experimental determinations of the area have been made by the interposition of a sheet of tissue paper and a sheet of thin carbon paper between the wheel and rail, and by measuring the area of the impression left by the latter on the former. This method cannot be regarded as completely satisfactory, for however thin the two papers may be they are bound to affect the result and that to an extent concerning which we have no information. Moreover, the method measures the area alone and does nothing to enlighten us regarding the distribution of stress over it. Nevertheless, the observations made by Mr. Beaumont and his committee, and the conclusions that have been drawn therefrom, are sufficiently satisfactory to convince us that the maximum stress between the tire and rail must in many cases, both on tramways and railways, exceed the elastic limits of the materials of which they are composed. By how much it goes beyond that point in any given case some considerable degree of doubt must generally remain.

Beyond the establishment of the fact that the cause of corrugations is to be found in the applied maximum stress exceeding the elastic limit, the committee's report does not add much information to what already exists on the subject. It tells us, for instance, nothing as to what is the best way to avoid the trouble in any particular instance, whether that is to say it is best to increase the size of the wheel, to adopt a lower wheel load or lesser speeds, or to seek improved materials for the tires and rails. Nor does it convey any information as to whether the slightest excess of the maximum applied stress beyond the elastic limit will sooner or later cause corrugations or whether—as we suspect will be found to be the case—the elastic limit can quite safely be surpassed to a fairly considerable extent without doing any harm. The farther extension of the committee's work here indicated can obviously only be undertaken when greatly improved experimental means and a sound mathematical theory of the distribution of the stress over the area of contact are available. In this connection we would suggest that the subject is one eminently suited for investigation in certain of its aspects by the optical methods developed by Professor Coker. That it is well worth pursuing beyond the point at which Mr. Beaumont's committee apparently now proposes to leave it, we have no hesitation in affirming, for it is a subject of very considerable moment to railway engineers, as well as to those connected with the operation of tramways.

## Obituary.

### EDWARD HOPKINSON.

THE death occurred on Sunday last, at his home, "Ferns," Alderley Edge, of Mr. Edward Hopkinson, at the age of sixty-two. The fourth son of the late John Hopkinson, Edward was educated at Owens College—now Manchester University—where he was Dalton Mathematical Exhibitioner. Later, in 1877, he gained an Exhibition in Mathematics at Emmanuel College, Cambridge, as well as a foundation scholarship. After graduating as Tenth Wrangler in the Mathematical Tripos in 1881, he became a Fellow of his college in 1883. About this time Mr. Hopkinson took the degree of Doctor of Science at London University in the mathematical treatment of electricity and magnetism. In 1882 he became assistant



EDWARD HOPKINSON

to Sir William Siemens and carried out experiments on the first electrical tramway in the United Kingdom, at Portrush. In the following year he designed the electrical equipment of the Bessbrook and Newry Tramway, which is operated by water power. He wrote a paper on the construction and operation of this tramway for the Institution of Civil Engineers and was awarded a gold medal and the Telford Premium.

In 1884 Mr. Hopkinson joined the Manchester firm, Mather and Platt, where his great electrical knowledge found ample scope. He was made a partner in 1887, and a managing director in 1892 when the firm was made into a limited liability company. Later, when the firm absorbed the undertaking of Dowson, Taylor and Co., Mr. Hopkinson was appointed vice-chairman. It will be recalled that Messrs. Mather and Platt obtained the contract for the electrical equipment of the City and South London Railway—the first "tube" in the country. For a paper which Mr. Hopkinson read before the Institution of Civil Engineers on the subject in 1893 he was awarded the Telford and George Stephenson Premiums and Medals. The Douglas and Laxey Tramway and the Snaefell Mountain Railway, both in the Isle of Man, were constructed somewhat later, and their electrical equipment was designed by him. Another electric

tramway carried out by Messrs. Mather and Platt under Mr. Hopkinson's guidance is that from Blackpool to Fleetwood.

Mr. Hopkinson did a large amount of public work. Amongst the prominent positions which he filled were the presidencies of the Institution of Mechanical Engineers and of the Manchester Association of Engineers. He was a member of Council of the Institution of Electrical Engineers, vice-president of the Manchester Steam Users' Association, and one of the founders of the Engineers' Club. He was a member of the Indian Industrial Commission which was in being from 1916 to 1918, and served on the Industrial Fatigue Research Board of the Department of Scientific and Industrial Research.

Mr. Hopkinson entered Parliament in the Unionist cause in November, 1918, as the member for the Clayton Division of Manchester. In that election he defeated the sitting Labour member, Mr. J. E. Sutton, by a very large majority. Mr. Hopkinson's health had been indifferent for some time and his death was due to bronchitis.

## JOHN WEST.

BY the death of Mr. John West, which occurred last week at Southport in his eighty-second year, the gas engineering industry has lost one of its pioneer members. Mr. West commenced his industrial career with Mr. John Gunson, engineer to the Northampton Gas Company, in connection with the manufacture and sale of gas stoves. After fulfilling appointments at Hastings and Maidstone, he was appointed chief engineer of the Manchester Corporation gas undertaking in 1879, a position he held until 1884. While engaged at Maidstone, Mr. West was responsible for the introduction of labour-saving devices in the retort house. In 1874, a company known as West's Gas Improvement Company was formed, for the purpose of manufacturing and installing West's stoking machinery. So successful was the venture that Mr. West resigned his appointment with the Manchester Corporation in 1884 to take up the duties of managing director of the company, the works or which are at Miles Platting. Since that date the machinery which he designed, has been installed in all parts of the world. In 1906, in collaboration with Mr. Samuel Glover, the Glover-West system of continuous carbonisation of coal in vertical retorts was introduced, and one of the earliest appliances for this purpose was purchased by the Manchester Corporation in 1909. Since that time, other installations of a similar kind have been adopted in Manchester and elsewhere. In 1890-91 Mr. West was President of the Manchester Association of Engineers, a post which his son, Alderman Frederick J. West, who is in the same line of business, now occupies. Mr. West was also a member of the Institution of Mechanical Engineers. He was a man very highly respected amongst a wide circle of friends.

# Letters to the Editor.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

## ROPE DRIVES.

SIR,—Some time ago you allowed me a great deal of your space in a discussion on "Belt Drives." May I ask for further space? Whilst going through my papers I have just come cross this discussion, and observe that one of your correspondents, to whom I suggested that his difficulty might call for the use of the so-called American type of rope drive, raises the objection of the "terrific speed of the tension pulley which soon wears out."

I did not deal with this objection at the time, since the subject was "belts" not "ropes," and it is best to keep to one thing at a time. The objection showed, however, that your correspondent was not aware of the correct method of design for such a drive, and since no one else has done so, I may perhaps usefully make a few remarks on this question.

First let me observe that "terrific speed" of tension sheave is a mere bogie, which does not and cannot exist in a properly designed drive of the type referred to, which, as all your readers will know, is that in which a single length of rope is wound over the grooves of the drive sheaves as many times as required, the two ends being then spliced together, forming a bight in which the tension sheave lies. Hence the drive is sometimes called the "continuous" or "single splice" system.

Now, since every part of the rope necessarily travels at the same speed, since, if not, some parts of the rope would have to slip in their grooves, there can be no multiplication of speed such as obtains in the case of a block tackle.

The cause of excessive speed is that the tension sheave is of smaller diameter than the small sheave of the drive. This is a fault of design not infrequently met with, and causes heavy wear to the rope and pulley, noise and general bad running. The diameter of the tension sheave should never be of the same or less diameter than the smaller sheave of the drive, but always larger in diameter, and in some cases much larger. This latter condition obtains when the main drive sheave is wide relative to its diameter.

The tension pulley, from consideration of cost, should run in conjunction with the smaller sheave of the drive. This also allows room for the tension sheave to travel to and fro between the driving and slack parts of the drive without involving unequal spacing of the outer driving rope grooves. The tension sheave being larger than that of the drive, necessarily runs at a lower speed, whilst since the bearings of the tension sheave have to bear a very small part of the load on the driving shaft, wear of an abnormal character should not occur here.

Wear in the groove of the tension sheave is simply due to the rope not being at all points between main and tension sheave truly in the plane of the latter, and this condition is simply due to an incorrect diameter of tension sheave being chosen. To avoid wear of rope and groove, it is obviously necessary that the rope should at all points lie in the plane of its groove. Imagine two planes, one A passing through the driving axes and another B at right angles to A and lying parallel to the driving rope grooves. Then to fulfil the condition that the rope always lies in the plane of its groove, it is clear that the tension pulley diameter, measured at the rope centres, projected on to plane A, must be the same as the distance apart of the two outer grooves of the driving sheave.

Also, a little consideration will show that to obtain the same condition in the case of the tension sheave which lies at an angle—not a right angle—to both planes A and B, it is necessary that the two parts of the rope leading to this sheave must be parallel, not only to themselves, but to both planes A and B, which condition involves that the projection of tension sheave on to plane B must equal the diameter of the driving sheave For let this projection be less, then one or both of the rope parts lie at an angle to the plane of tension sheave depending on the distance apart of the sheaves.

Clearly to visualise this, let the tension pulley be of a diameter equal to pitch of outer driving grooves, and lying with its plane in plane A. The angle of error of lead of rope with reference to tension sheave is readily seen and its varying amount.

Whilst, if the tension sheave is made of a diameter $= \sqrt{A^2 + B^2}$ where A and B = projections on to respective planes, the tension sheave can travel its full range with no error of rope lead.

Angmering, January 4th. GEO. T. PARDOE.

## THE INTERNAL COMBUSTION TURBINE.

SIR,—In a leading article in THE ENGINEER of September 23rd, 1921, an interesting summary was given of some of the problems that await solution before the internal combustion turbine can become a reality. It was suggested that, baffling as the production of a satisfactory design would seem to be at present, it was difficult to avoid the feeling that a solution might be afforded at almost any minute.

Among other matters touched upon, attention was called to the unsatisfactory nature of the present-day rotary compressor, due to the bulk of gases to be dealt with and low peripheral speed permissible, and to the losses occurring in the turbine.

The Diesel engine, being a reciprocating engine, has a high mechanical efficiency, and it is unlikely that any internal combustion turbine will be able to rival it in overall efficiency when working between the same expansion limits. To compete with the Diesel engine or steam turbine it will be necessary for an internal combustion turbine to work on a sub-atmospheric cycle or on a cycle which may be an extension of the super-atmospheric Diesel cycle by means of further expansion below the atmospheric line. The difficulties on account of size of compressor will be accentuated, however, on account of the large specific volumes of the gas at the lower pressures proposed.

One source of loss, which perhaps could be turned to useful account, is the kinetic energy remaining in the exhaust gas after passing through the moving blades of the turbine. Considerable economy should result if this energy could be made to do part of the negative work of compression. It might be found possible to dispense altogether with the blades of the compressor and utilise the velocity of the exhaust gas to raise its pressure. The large increase in gas velocity obtainable would very substantially reduce the bulk of the compressor. In this kinetic compressor the exhaust gas would enter and leave tangentially one or more circular chambers in which the kinetic energy of the gas would be converted into pressure energy by the joint action of the centrifugal force caused by the constrained motion in a curved path, and the action of a spinning mass of gas kept in rotation by absorbing a portion of the energy of the gas entering the compressor. In a compressor of this type the gas would be always in a state of deceleration, unlike that in the usual mechanically driven rotary compressor, in which the gas is accelerated and decelerated perhaps ten times in the course of compression, with consequent loss in eddy motion and shock, apart from the intricacy of the path of motion.

To be able to use apparatus of this character it would be necessary to produce and maintain the vacuum by some external means. One way of doing this would be to expand gas (operating gas) in which fuel had been burned, from a pressure greater than atmospheric through a nozzle system on the exhaust side of the turbine, and thus produce a sub-atmospheric pressure which would induce gas, in which fuel had been burned at atmospheric pressure, to expand down to the vacuum pressure and pass through the moving blades of the turbine. In this way it should be possible to induce through the turbine a weight of gas several times that of the weight of operating gas used to produce the vacuum. The whole of the mixed operating and induced gas would pass through the cooler and kinetic compressor and be discharged at atmospheric pressure.

The compression of the operating gas could be carried out by an independent compressor of ordinary type of much smaller bulk than would have been required if it had to deal with all the gas passing through the turbine, while the kinetic compressor dealing with the mixed operating and induced gases would be relatively of a much smaller size when compared with a mechanically operated rotary compressor owing to the high gas velocities used.

It is hoped that the foregoing remarks may be of interest to your readers and stimulate a further study of this most important problem. HENRY A. HEPBURN, B.Sc. (Eng.), London.

Birmingham, January 14th.

## SOME POINTS ON MANUFACTURING.

SIR,—The article in your issue of December 30th, 1921, extolling the methods and lay-out of the Ford works is of considerable interest, but there is nothing novel there mentioned, or, we might even say, nothing but what has been published elsewhere previously. For example, thirty-five years ago wholesale clothing manufacturers in Leeds were cutting piles of cloth exactly as shown in your illustration on page 696. We are certainly inclined strongly to deprecate the tone of the article, because it is of the Yellow Press type, by which we mean that it advertises Ford methods and does not attempt to do justice to efforts made in this country to get a large output of much higher grade cars at the lowest possible cost by employing multiple drills and specially designed machines, &c.

This company started at the time of the Armistice on a programme of manufacturing on mass production lines, and the whole works has been laid out in such a way that we have proved conclusively that our calculations and special machines and tools can give the output expected, and which could fairly easily be increased if the demand were forthcoming.

At the time of the Armistice about 20,000 were employed entirely on munitions. Since November, 1918, the whole plant has been re-arranged, new plant installed, thousands of special tools designed and made, and many thousands of cars and tractors have been delivered. We feel that this is no mean achievement, and though we have no desire to belittle the Ford methods or results, we do strongly feel such attacks on British works as are contained in the article referred to are by no means just. Given the demand, we can do equally as well in Britain as in any other country; in fact, we believe we are correct in saying that certain parts of Ford cars sold in this country are made here and not in the U.S.A.

FOR THE AUSTIN MOTOR CO., LIMITED,
F. C. DOLBY,
Superintendent of Tool Design and Manufacture.

Birmingham, January 5th.

[Our object in printing Mr. Stromborg's article was not to extol the Ford method of production, but to call attention to its influence on the labour problem in the United States of America. —ED. THE E.]

## THE NEW GAS CHARGES.

SIR,—Your remarks in THE ENGINEER of current issue are interesting, but, may I say, unconvincing. You imply that the consumer now pays only for what he gets, and you say that diluents are of no value to the gas maker. May I be allowed to disagree?

When gas was supplied on an "illuminating value" basis the old-fashioned "batswing" burner occasionally used gave the consumer a visible means of detecting any serious falling off in the quality of the gas supplied, irrespective of the negligence of a local testing authority. Under the new conditions, however, no such ready and informal check is available, the thermal quality of the gas being invisible. Unless and until it is possible to meter "therms" *per se*, the consumer has in *principle* no more security that he actually gets what he is charged for than he had before this change, and in *practice* he has less, by the absence of the informal check previously mentioned.

The consumer's nominal security is the official test, which he had, such as it was, before this change. Such official check is often, in the smaller towns, controlled by the Urban District Council, the members of which, being often gas shareholders, cannot always be trusted to uphold the consumers' interests as against the local gas company.

The consumer is charged on the result of an arithmetical calculation of the product of *assumed* B.Th.U. per cubic foot into the cubic *feet* metered. To check his bill, therefore, the consumer has a calculation to make in addition to reading his meter. *Cui bono?* Further, since gas is metered by "quantity," diluents work the meter just as well as useful gas. This change in basis of charges is bastard science. The change concerns the gas maker alone directly. The consumer is only concerned by the possible lower cost lowering the price.

Angmering, January 14th. GEO. T. PARDOE.

## LOCOMOTIVES WITH FOUR EXCENTRICS.

SIR,—Mr. Dunlop, in his letter in THE ENGINEER of January 13th, quotes "The History of the Locomotive in America." May I ask what history is referred to, who was the author, and what evidence is produced in support of the statements made in relation to the present question? I note that Mr. Dunlop does not give his authority for the statement that the Swiftsure was rebuilt with Carmichael's valve gear. It is, of course, quite possible that locomotive lists did not record alterations. It appears, however, that no better or more authentic evidence than Allan's can be produced on the four-excentric problem, and, if that be accepted, it is clear that the Forrester engine Swiftsure and the Dublin and Kingstown engines of 1834 must have been so fitted before Hawthorn's Comet of 1835.

Wembley, January 16th. E. A. FORWARD.

## BOOKS RECEIVED.

*The Blacksmith's Pocket Book.* By Tom Wormald. London: Scott, Greenwood and Son, 8, Broadway Ludgate, E.C. 4. Price 6s. net.

*The Distribution of Gas.* By Walter Hole. Fourth edition. London: Benn Brothers, Limited, 8, Bouverie-street, E.C. 4. Price 50s. net.

*Factory Administration in Practice.* By W. J. Hiscox. London: Sir Isaac Pitman and Son, Limited, Parker-street, W.C. 2. Price 8s. 6d. net.

*Modern Gasworks Practice.* By Alwynne Meade. Second edition. London: Benn Brothers, Limited, Bouverie-street, E.C. 4. Price 55s. net.

*Fuel and Lubricating Oils for Diesel Engines.* By W. Schenker. London: Constable and Co., Limited, 10–12, Orange-street, Leicester-square, W.C. 2. Price 18s. net.

*Modern Methods of Welding as Applied to Workshop Practice.* London: Constable and Co., Limited, 10–12, Orange-street, Leicester-square, W.C. 2. Price 21s. net.

*The Book of the Ford.* Sixth edition. How to get the best out of a Ford. By R. T. Nicholson. London: Temple Press, Limited, Rosebery-avenue, E.C. 1. Price 3s. net.

*The Vacuum Automatic Brake, with a note on Slipping Carriages.* London: The Locomotive Publishing Company, Limited, 3, Amen-corner, E.C. 4. Price 2s. 6d. net.

*Electro-deposition and Electro-plating.* Report of a general discussion held at Sheffield during November, 1920. London: The Faraday Society, 10, Essex-street, W.C. 2. Price 10s. 6d. net.

*A Catalogue of British Scientific and Technical Books.* Covering every branch of science and technology, classified and indexed. London: The British Science Guild, 6, John-street, Adelphi, W.C. 2. Price 10s. net.

*Ypres to Verdun.* A collection of photographs of the war areas in France and Flanders. Specially taken by Sir Alexander B. W. Kennedy, F.R.S. London: Country Life, Limited, Tavistock-street, Covent Garden, W.C. 2. Price 15s. net.

## The Physical and Optical Societies' Exhibition.

No. II.*

THE Crompton Robertson combination bridge and potentiometer shown in Fig. 8 was exhibited by Crompton and Co., of Chelmsford. The instrument has been designed for use mainly in educational laboratories, but it is quite suitable for use as a standard low-grade potentiometer with an accuracy of one part in a thousand. The complete set consists

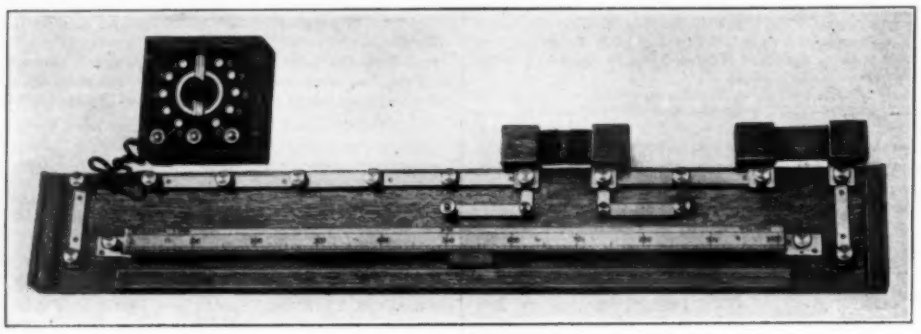


FIG. 8—CROMPTON-ROBERTSON BRIDGE AND POTENTIOMETER

of a slide wire bridge with a calibrated slide wire, a ten-coil dial resistance box, a standard 1 ohm. resistance and a standard 100 ohm. resistance, both suitable for fixing directly into the gap of the bridge. There is an alternative detachable slide wire which for some experiments may consist of a thick copper wire. With very few accessories beyond the dial box and the standard 1 ohm. and 100 ohm. resistances, the range of the bridge is surprisingly large, reaching from about 50 microhms to about 50,000 ohms. In the college laboratory it not only takes the place of the ordinary bridges, but except for the most accurate standardisation work, it can be made to supersede the more expensive Carey Foster bridge, conductivity bridge and potentiometer.

George Kent and Co., Limited, were showing a steam flow meter of the diaphragm type designed to give a graphic record of the variations in the flow of steam over a period of twenty-four hours or a week. The instrument is operated on the differential pressure principle, and it is suitable for measuring superheated or saturated steam. Elliott Brothers, of Century Works, Lewisham, were showing a collection of their standard electrical instruments. Other electrical instrument firms represented were Everett, Edgcumbe and Co., Limited, Nalder Brothers and Thompson, Isenthal and Co., Limited, the Weston Electrical Instrument Company, Eversheđ and Vignoles, Siemens Brothers and Co., Limited, and the Cox Cavendish Electrical Co., Limited. Some so-called "super-scale" ammeters and voltmeters shown by Everett, Edgcumbe have been designed so that an angular deflection of over 120 deg. is obtained, and the instruments have a scale length nearly 50 per cent. in excess of the usual extent. The firm was also showing an Everett, Edgcumbe-Abraham extra high-tension electrostatic voltmeter, suitable for a pressure of 100,000 volts. The Hewittic Electrical Co., Limited, was showing photographic enlarging outfits, &c., fitted with Cooper-Hewitt mercury vapour tubes. Electric furnaces of various types were shown by A. Gallenkamp and Co., Limited.

The electric revolution counter, illustrated in Fig. 10, was the most original device exhibited by Eversheđ and Vignoles. It is designed for counting the number of revolutions of an engine or the number of other mechanical operations at a point situated at any desired distance away from the engine or other machine. For speeds up to 400 revolutions per minute the apparatus is made to count single revolutions, but if it is desired to count at a higher speed than this the transmitter is geared down from the revolving machine so as to count one in every ten revolutions, and a nought is added at the unit end of the counter dial. The counter, which, as shown in Fig. 10, resembles in appearance an ordinary mechanical counter, works on a new principle. It is combined with a "step by step" motor driven by current obtained from ordinary electric light mains. Whilst the motor must be sufficiently powerful to rotate all the counter dials simultaneously when required, it must not move them with sufficient violence to involve risk of damage to the first dial when it is rotated. The ordinary mechanically locked counter is considered to be unsuitable because it is liable to stick when all its dials are moved simultaneously, and therefore requires a considerable reserve of power. In this new counter each dial is arranged to be locked mechanically in any of the ten positions corresponding to the digits 0 to 9, but mechanically they are entirely independent except during the time when a change of indication is taking place. The effect of this locking system is to enable each unit to be made with very little friction, and it offers the additional advantage of helping to reduce the power necessary to change the indication of all the dials simultaneously. Moreover, whilst the "step by step" motor gives ample power for moving the parts of the counter, its elements are light enough to enable it to work with certainty up to speeds exceeding 400 revolutions per minute. The motor is of the rotary type and is devoid of reciprocating parts, and only requires two wires to work it instead of three wires as generally used with devices of this sort. It will work satisfactorily on 70 per cent. of its normal pressure, and its internal resistance is such that no variation of contact resistance in the transmitter will affect its proper working. The transmitter, which is a plain make-and-break mechanism, is made in various forms to suit different requirements.

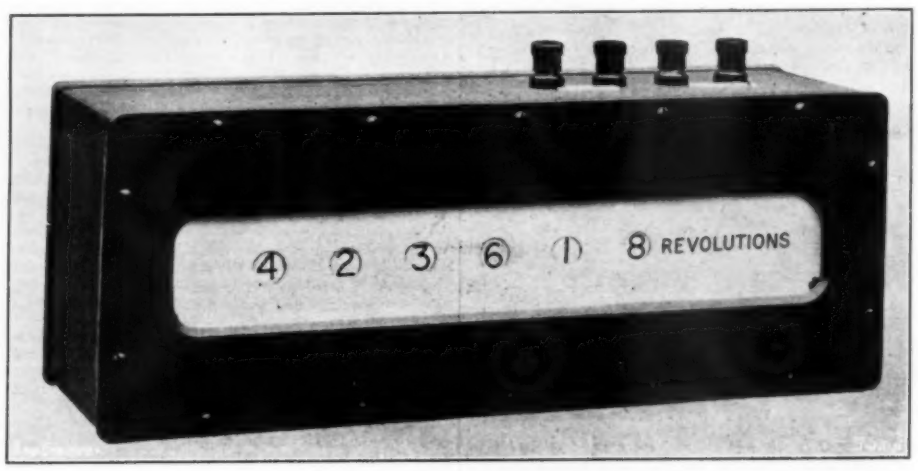



FIG. 10—NEEDHAM'S ELECTRICAL REVOLUTION COUNTER

Several distinctly interesting and novel exhibits were displayed on the stand of the Igranic Electric Company. The Igranic tubular heaters were, on account of their special form of construction, examined with great interest by a large number of visitors. A section showing the principle on which these heaters are made is shown in Fig. 9. The resistance A, composed of round wire, is wound in a helix which is placed inside the tube C, and the wire is separated from the tube by insulating material B. Usually the resistance is composed of nickel chromium, whilst the tube is made of steel or copper according to the use to which the heater has to be put. For general purposes steel tube is used, and copper tube for immersion heaters. A mica sleeve E serves for insulating the terminals at each end of the tube. The insulation between the resistance coil and tube is a specially developed, highly refractory material, capable of operating at high temperatures without deterioration. No mica is used apart from that which is employed at the terminals. The terminals are of brass or steel, the latter being adopted for high temperatures where brass would not be suitable, and brass where steel would be liable to rust. Generally a copper tube heater has brass terminals, and a steel tube heater steel terminals. The lead wire connecting the terminals to the resistance is of nickel chronium having a much greater section than the heating resistance, and it therefore gives an inactive length of tube so that the heating effect is confined to the portion of the tube desired. In the case of immersion heaters the tubing containing the resistance is shaped as required, and the terminals are brought out at a suitable point and passed through glands. The tube can be bent to conform to the shape of the vessel and to avoid obstructions. These tubular heaters are particularly suitable for use as "cast-in" heaters as they can be shaped to any desired form and will stand the temperatures at which aluminium, copper, brass or even iron are cast. Conduction heaters of this type are usually clamped to the part to be heated and it is desirable to provide grooves in which the heater will fit fairly closely so as to secure the maximum conduction of the heat generated. This is a simpler and cheaper method of applying the tubular heater to a casting than that of casting it in, and in many cases is just as satisfactory. Fig. 11 shows a 1500 watt oven heater. Radiant heaters may be obtained by simply suspending the tubes in the air.

Igranic tubular heaters are standardised in four diameters:—*i.e.*, $^{9}/_{32}$in., $^{29}/_{64}$in., $^{9}/_{16}$in. and $^{21}/_{32}$in., and made in any length up to a maximum of 60in. The permissible watt rating is determined by the work the heater has to perform, and varies from 60 watts per inch of actual length in the case of the smaller diameter tube used for water immersion, down to 12 watts for air heaters. The helix is kept central in the tube, and it is not, it is said, displaced by bending the tube. The limit of the bending radius in the case of the smallest diameter heater is $\frac{1}{4}$in. As the tubing is thoroughly annealed it can be bent cold. The advantages claimed for these heaters are: (1) The insulation is unaffected by high temperature; (2) freedom from expansion troubles; (3) no soldered or other joints to open up; (4) adaptability by reason of ease of bending, casting in, &c.; (5) elimination of mica, permitting high temperatures; (6) small diameter permits application in restricted positions; (7) high insulation value; (8) great regularity in duplication owing to standardised manufacturing methods; and (9) high thermal efficiency.

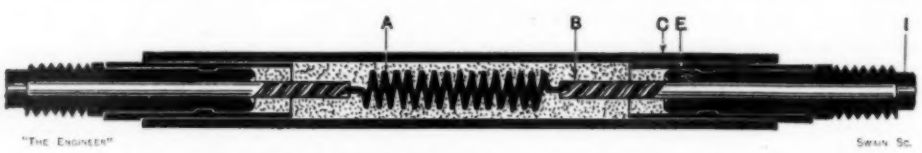



FIG. 9—SECTION THROUGH IGRANIC TUBULAR ELECTRIC HEATER

A small automatic triple pole starting switch for use on alternating current systems was another interesting Igranic exhibit. The starter, which is shown in Fig. 12, is used with small squirrel cage motors and motors with internal starting arrangements, which enable the stator windings to be directly connected to the line. A no voltage release gear opens the main circuit in case of failure of voltage, whilst inverse time limit overload protection is obtained by the use of a pair of mercury overload relays. The motor is allowed to take the extra current required for starting, but if current in excess of the normal running current flows through the motor windings too long and the windings heat up, the temperature of the thermal elements of the relays increases proportionately. This vaporises the mercury in the tubes of the overload relays, and causes it to pass into an upper chamber and open the circuit of the no-voltage release. This in turn disconnects the motor from the line, after which the mercury cools and the relays are reset in readiness for subsequent use. These starters are controlled by means of "start" and "stop" push buttons.

The Cox-Cavendish Electrical Co., Limited, was showing one of Professor Taylor Jones electrostatic oscillographs for use with potentials of from 5000 to 250,000 volts. The instrument consists—see Fig. 13—of a strip A of phosphor bronze or steel 1.75 cm. long

* No. I. appeared January 13th.

stretched between substantial ebonite jaws, and the tension can be adjusted by means of a nut and sliding screw. A mirror B of elongated form is attached at one end to the centre of the strip while the other end rests on an adjustable ebonite pillar C which forms a fulcrum, so that the mirror rocks through a small angle in response to any motion of the strip. The movement is immersed in oil, the liquid serving both for insulating and damping purposes. Opposite to the centre of the strip is the attracting plate E, embedded in an ebonite rod F which passes through the container wall, while on the side of the strip remote from this is a small plate of metal D in electrical connection with the strip. A window G in the container gives a beam of reflected light for observation

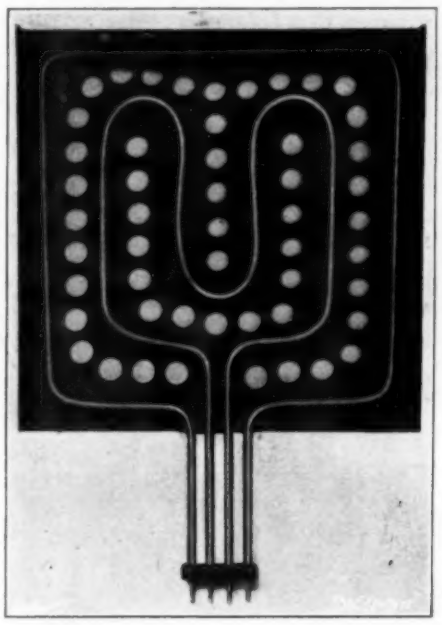


FIG. 11—IGRANIC ELECTRIC HEATER

or recording. For different ranges of potential different containers fitted with attracting plates at different distances and shielded by different thicknesses of ebonite are used, the movement being the same in each case. The deflections are, of course, proportional to the squares of the potentials.

In addition to the Taylor Jones' electrostatic oscillograph, the Cox Cavendish Electrical Company was showing a gold leaf electroscope, designed by Dr. E. A. Owen, of the National Physical Laboratory. The gold leaf A—see Fig. 14—is attached to a rod B, which is screwed into an insulator D of ebonite with rings of sulphur. The charging rod F is capped

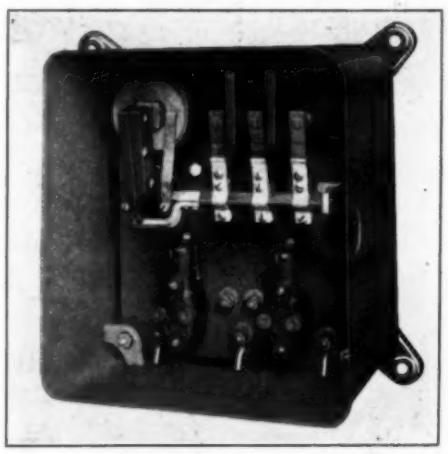
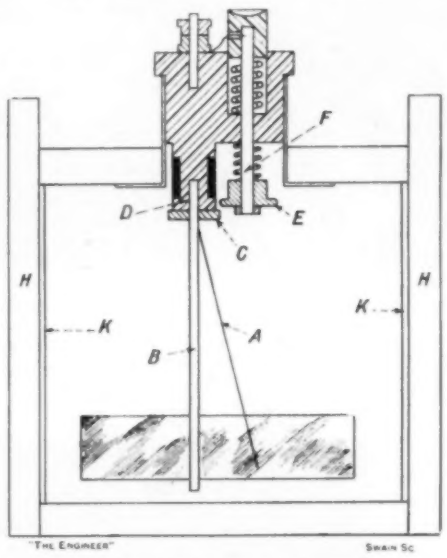


FIG. 12—IGRANIC STARTING SWITCH

with ebonite and is held in its upper position by a spiral spring. A loose flange E is maintained in the position shown by a weak spring, but when the rod F is depressed it makes contect with a flange C on the rod holding the gold leaf. Thus the instrument cannot be injured by pressing down the charging rod too hard. The chief point to look to in an electroscope is the insulation of the leaf system. Ebonite is a poor insulator as regards surface leakage and deteriorates rapidly with exposure to a damp atmosphere. The best material to employ would be sulphur or amber. The former is ruled out in this case on account of its mechanical weakness, whilst the latter is at present difficult to obtain and suffers to some extent from the same defect as sulphur. The insulating properties of ebonite can be greatly improved by the old method of letting sulphur rings into it. This method is used in the present case and has been found to be satisfactory The gold leaf is about 4.5 cm. long, and the end of the leaf falls through about 0.11 mm. in one hour when the potential is kept at 280 volts, while a change of potential of 1 volt on the leaf moves it through 0.51 mm. The amount of soakage in the ebonite insulation is small, and reliable readings may be taken with the instrument in about 5 or 10 minutes after the leaf has been initially charged. For Y-ray measurements the whole of the electroscope is covered with lead about ¼in. thick, whilst for X-ray work the two lead end faces are removed and the rays pass into and out of the instrument at H through aluminium windows K of suitable thickness.

Siemens Brothers and Co., Limited, exhibited electro-pyrometric apparatus and a selection of galvanic cells and batteries. A temperature recorder exhibited has a continuous chart roll which lasts three months and is driven by clockwork, which requires to be wound once a week. The instrument can be calibrated for use with either thermo-couples or resistance thermometers. Owing to the very small electromotive forces developed—*e.g.*, about 10 millivolts at 1000 deg. Cent. with platinum rhodium couples—the employment of any ordinary form of recording pen is impracticable, as the friction between it and the paper would introduce serious errors. To surmount this difficulty a semi-transparent paper chart is used and a typewriter ribbon is stretched over a straight edge immediately under the paper and below the moving pointer. Every thirty seconds the pointer is pressed on to the paper by a clockwork




FIF. 14—OWEN GOLD LEAF ELECTROSCOPE

driven chopper bar and so makes a dot. A succession of these dots forms the record. Except at the moment when it is depressed on to the paper, the pointer is free to swing. Several types of temperature indicators were shown, including portable and wall types. The portable instrument does not require levelling and is supplied in a teak case with leather carrying handles. Two wall type indicators were shown, one with a horizontal pointer and intended for use more particularly with platinum, platinum-rhodium couples, and another water-tight but less sensitive type, with a vertical pointer for use with base metal couples. There was also a special locomotive pyrometer outfit, specially designed for use with the superheaters now fitted to most modern locomotives.

A radio frequency bridge was shown by Mr. W. H. Sullivan. The bridge is suitable for the measurement of resistance, capacity and inductance at radio frequencies. One of its chief features is a high frequency generator, which is used in place of the buzzer apparatus which has hitherto been employed for determinations of this character. Tests can be carried out under actual working conditions and the range of frequencies of the oscillator is between 10,000 and 500,000, the higher frequency representing a wave length of 600 m. Another exhibit was a fixed air condenser with a capacity of .001 microfarad, which has been designed in conjunction with the National Physical Laboratory and is made on the lines of standard condensers recently supplied to the Laboratory. The only insulating material used is quartz, and the condenser is not, therefore, liable to be affected by temperature. The metal cover forms a perfect earth screen, metal caps being fitted over all the insulators to render the screening complete.

Major Tucker's patented hot wire resonator microphone was also exhibited by Mr. W. H. Sullivan. This microphone was designed originally for determining the position or origin of a sound produced by the

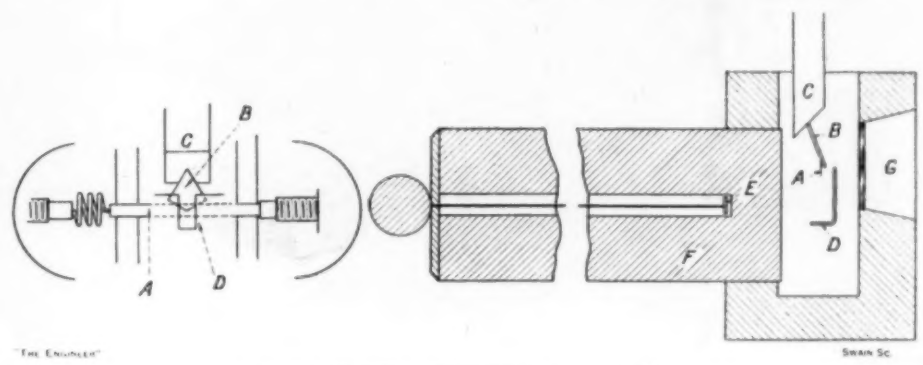



FIG. 13—TAYLOR JONES ELECTROSTATIC OSCILLOGRAPH

discharge of a gun and was largely used in the war. It has since, however, been employed for a number of other purposes. The microphone consists of an electrically heated Wollaston wire or grid which is mounted close to, and in front of, a small opening in a cylinder or container, the latter being closed at the other end, and the volume of air in the container can be varied by means of a plunger operated by a micrometer screw. The fine wire, which is supported in a frame, is connected to terminals. A current is passed through the wire for the purpose of raising the temperature above that of the surrounding air. In operation the temperature of the wire is reduced by the cooling effect of the blast of air caused by the sound to be determined or recorded, and if the ends of the wire are connected to a sensitive indicating galvanometer of the uni-pivot type a deflection of as much as 90 deg. is easily observed. The deflection depends, of course, upon the intensity of the particular sound wave which is affecting the microphone. The variation in the electrical resistance can be used in many ways. The best effect, however, is obtained by inserting the microphone in the arms of a Wheatstone bridge, which utilises to the best advantage any resistance variation in the microphone. In conjunction with an Einthoven galvanometer or other suitable instrument it can be used for recording the wave form of sounds of low periodicity, *e.g.*, within the range of 25 to 1000, or, if connected through a transformer and used in conjunction with a valve magnifier, sounds can be rendered audible over great distances.

## THE ACCIDENT TO A MIDLAND RAILWAY ENGINE.

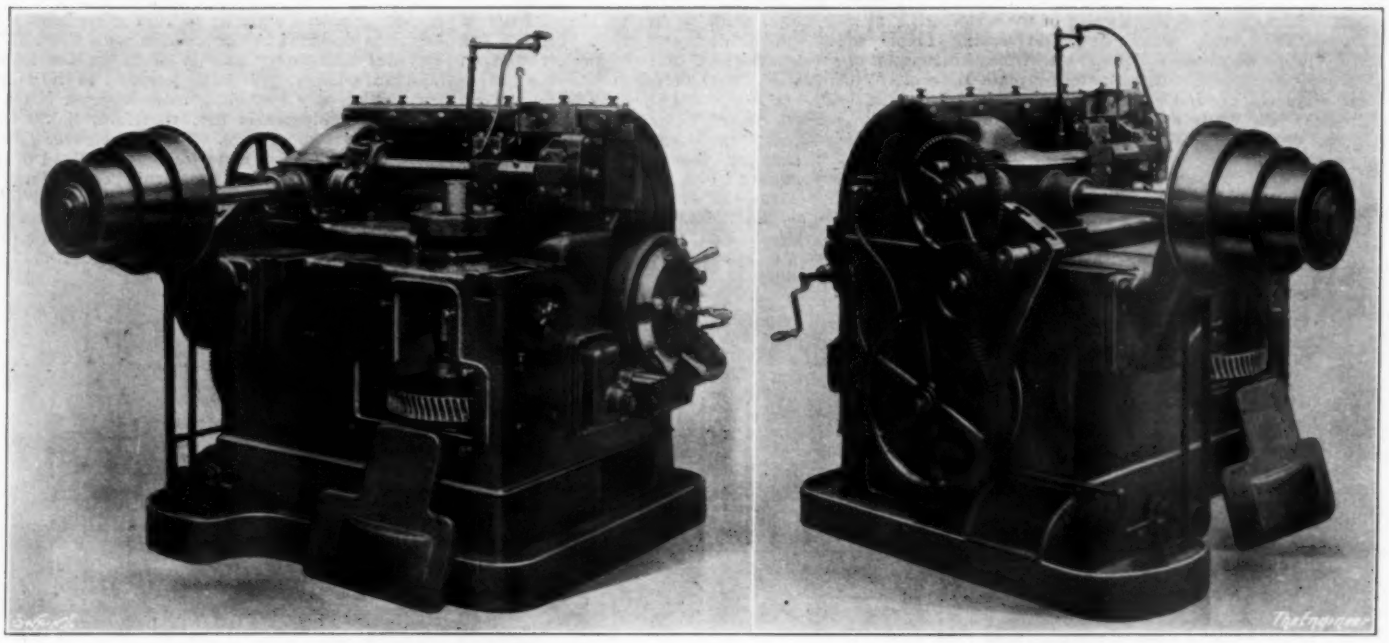
IN connection with the accident to a locomotive which occurred on the Southend section of the Midland Railway on Wednesday of last week, as a result of which the driver was killed, an inquest was held on the 14th inst., but was adjourned to permit the fireman, at present in hospital, to give evidence. On the 18th an inquiry was held by Major Mount on behalf of the Ministry of Transport. The report that the accident was caused by the explosion of the boiler has not been substantiated. It would appear that the trouble was originated by the breaking of some part of the machinery, which resulted in the connecting-rod breaking and piercing the fire-box.

THE INSTITUTION OF CIVIL ENGINEERS.—The Council of the Institution of Civil Engineers has made the following awards for students' papers read in London or at local associations during the sessions 1919–20 and 1920–21:—The James Forrest Medal and a Miller Prize to R. D. Gould, M. Eng. (Manchester); the James Prescott Joule Medal and a Miller Prize to J. E. Dumbleton (Birmingham); Miller Prizes to Henry Fowler (Manchester), G. H. Humphreys, M.A. (Manchester), C. M. Brain (London), J. T. Chalk (London), K. T. Spencer, M.C. (London), and E. A. Phillipson (London).

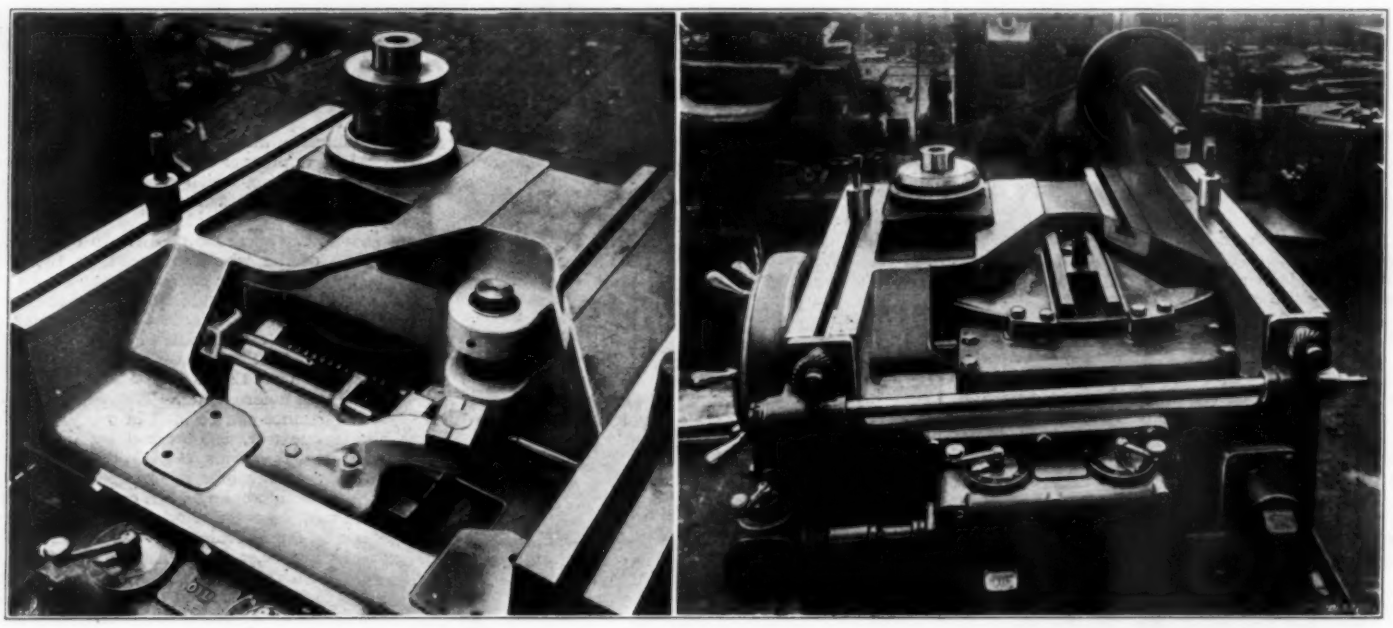
FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—The following is a list of officers elected to serve during the current year:—President: Mr. W. G. Head, M.I. Mech. E. Vice-presidents: Professor G. T. Morgan, F.R.S., Mr. A. J. Chapman, M. Inst. M.M., Mr. F. H. Masters, and Mr. W. J. Tennant, M.I. Mech. E. Members of Council: Messrs. J. H. Coate, Harley F. Knight, W. W. Bradfield, E. W. Moss, A.M.I.E.E., A.M.I. Mech. E., E. S. Conradi, and E. G. Walker, M.I. Mech. E., A.M. Inst. C.E. Hon. auditors: Messrs. L. M. Clark and F. R. C. Rouse. Hon. treasurer: Mr. W. Bernard Thompson, A.M.I.E.E., "Elleray," Regent-road, Altrincham, Cheshire. Hon. secretary: Mr. H. P. Guy, A.M.I.E.E., 74, Silver-street, Edmonton, N. 18.

# WORM GEAR GENERATING MACHINE

SMITH AND COVENTRY, LIMITED, MANCHESTER, ENGINEERS



FIGS. 1 AND 2—THE MACHINE AS SEEN FROM THE OPERATOR'S STATION AND FROM THE DRIVING SIDE



FIGS. 3 AND 4—FIRST AND SECOND ASSEMBLIES OF THE GENERATING MECHANISM

## A New Worm Gear Generating Machine.

A NEW worm gear generating machine, which is the outcome of several years' experience with the Smith, Major and Stevens machine, is now being placed upon the market by Smith and Coventry, Limited, Manchester. The new machine is claimed to be an advance in many respects on other tools designed for this class of work. It is smaller and more complete in its general adaptability than the original machine, and is the smallest of three sizes which the firm proposes to build, its capacity being 12in. between the centres of the worm and wheel. The machine is of the tangent feed pattern, and while powerful enough for driving jobs when the quantities warrant the expense of such tools, it is more particularly adapted to the generation of single wheels or wheels in small numbers by means of the less expensive fly cutter.

The compactness and rigidity of the machine are well illustrated in the engravings Figs. 1 and 2, the former of which shows the operator's side with the cover removed to expose the master worm wheel to view, and the latter the arrangement of gearing between the cutter spindle and the indexing worm. The other half-tone engravings, Figs. 3, 4 and 5, show the machine in different stages of assembling, and a fly cutter operating on a phosphor-bronze wheel. Figs. 6–9 show various sectional details of the machine to which reference is made hereunder.

The driving train is illustrated diagrammatically in Fig. 6. It will be seen that the cone running on ball bearings drives the shaft A by bevel gearing, from which shaft power is transmitted to the cutter spindle by the spiral bevels B and by change gearing C to the index worm shaft D and worm E. A feature of the machine is the absence of all differential gearing, with its complications, the change wheel train C being a simple train of the ratio of the worm gearing to be cut divided by the constant 10 of the machine; that is to say, with equal change gearing the worm wheel produced would have a ratio of 10 to 1. traverse of the hob or fly cutter, and this without the use of change gearing. Reference to Fig. 7 will make this mechanism clear. The work spindle F and its worm wheel

FIG. 5—FLY CUTTER IN OPERATION ON A WHEEL

The patented generating mechanism is interesting, as it is a direct application of simple geometrical principles by which the wheel blank receives an added movement corresponding exactly at the pitch line with the tangential G are revolved by the worm E, which is geared to the cutter spindle by change wheels as already described. The worm is, however, longer than would be necessary if this simple revolution alone were required, and it has

thrust bearings on a slide H lying parallel with the cutter spindle D. Movement of the slide H will therefore cause revolution of the work spindle F irrespectively of whether the worm E be revolving or stationary. The cutter slide J carries removable bearings for supporting the cutter arbor, and moves in guides in a head K, which can be moved by parallel screws upon the bed to bring the cutter arbor centre to any desired distance from the centre of the spindle F. The slide J also has a downwardly projecting member carrying a pin and slide block L engaging a radial groove in the generating lever M, which also engages the index worm slide in a similar manner by the block and pin N on the slide H.

The lever M is moved about its pivot O by a worm P engaging a sector of teeth. Angular movement of the lever M causes, by means of the slide block connections L and N, simultaneous movement of the cutter slide J and the index worm slide H. The ratio of these movements is governed by the position of the dies in their slots as represented by the distances X and Y in Fig. 7. The distance X is exactly the pitch line radius of the index worm wheel G. Then if Y be exactly the pitch line radius of the worm wheel being cut, the hob or worm cutter D will receive the correct rolling generating movement relatively to the blank which is being operated upon. The distance Y is adjusted by a second slide carried by the cutter slide, measuring faces Q being provided, which are a known distance apart when $c$, the pitch line radius of the hob, is zero. Calling this known distance $k$, the distance apart of the measuring surfaces Q must then be $k - c$, where $c$ is half the pitch diameter of the worm. The above method of end measurement for setting is also used in connection with the setting to centres of the cutter spindle and wheel, and also for setting the fly cutter in the cutter spindle. The method permits the use of simple end-measuring rods between the measuring faces. The gauge for setting the fly cutter fits upon a locating edge on the slide and consists of a sliding rod R having a collar at its upper end. This collar rests upon the gauge casting when the bottom end of the rod is level with the centre of the cutter arbor, so that by the use of a rod gauge Z of length equal to half the diameter of the hob represented by the fly cutter, the correct setting of the latter can very readily be effected. The gauge is, of course, removed after setting the cutter, but the rod can be left clamped in position ready for future re-setting. Whilst Fig. 7 would suggest that the cuttings drop directly upon the generating mechanism, this is not the case, the design of the moving head K being such that it is always covered so that no cuttings can reach the mechanism.

In Fig. 3 are seen the long index worm with its slide and die connection and the pivot O for the generating lever. The automatic trip rods are also seen, by which the tangential movement of the index worm slide is caused to trip the automatic feed mechanism at either end of the tangential travel. The hollow space forms a chip chute, which delivers the cuttings to the hole seen near the base in Fig. 2.

In Fig. 4 is shown a farther step in the assembly, in which the generating lever M is in position with its lock and pin L for connecting the cutter slide. Provision, it will be seen, is made for supporting this lever at its outer circumference at points near to the place where the worm acts upon it. The feed box, shown in Figs. 3 and 4, has a range of more than 140 to 1, in twenty steps, without any objectionable speeding up on the faster rates of traverse. The necessity for so wide a range of feeds in this machine will be appreciated after considering that in a worm wheel of many teeth but of low ratio the worm may have to revolve many times before the cutter again acts upon the same tooth. In such cases the feed must be very slow in relation to the revolutions of the work and its index worm, whilst on wheels of low ratio, in which the number of leads in the worm divides into the number of teeth of the wheel without remainder, the index worm makes very few revolutions before the cutter again acts upon the same tooth, in which case a fairly rapid rate of traverse is desirable. The trip mechanism is of the instantaneous type, in which the clutch is released in about one-eighth of its own revolution, notwithstanding that the worm slide which is operating the trip mechanism may be moving very slowly.

Referring to the provisions made for using fly cutters, Fig. 8 shows a section of the driving sleeve, with its inward projecting feather engaging a corresponding groove in the cutter arbor S. The latter runs in adjustable bearings, which are such that simple bushes can readily be made by the user to pass clear of the worm wheel being operated upon, whilst giving ample support to the cutter arbor. The fly cutter T has a cylindrical body with a flat against which the central clamping screw U engages. The clamping force being thus central, the cutter arbor is not distorted as might be the case with cotters or wedges. Any thrust on the cutter arbor in either direction is taken by the ball thrust V carried by one of the bearings.

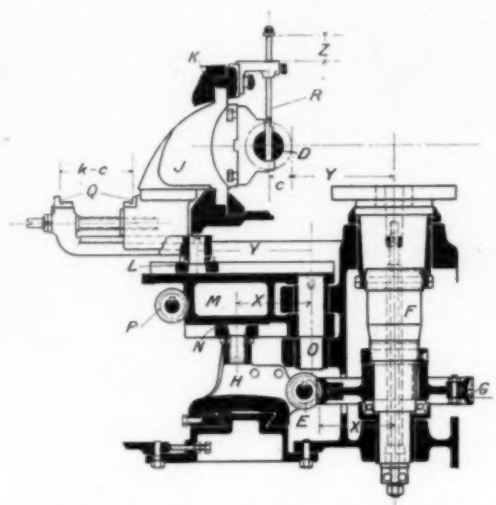
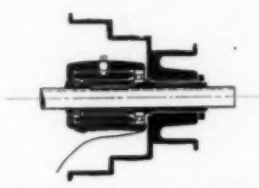



Fig. 7. Sectional View of Generating Mechanism.



Section of Cone & bearings.

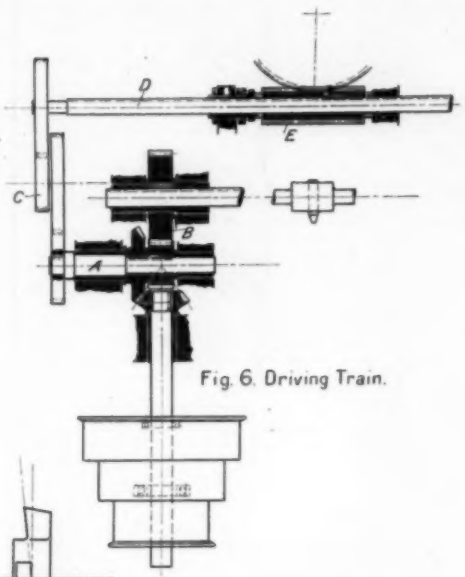
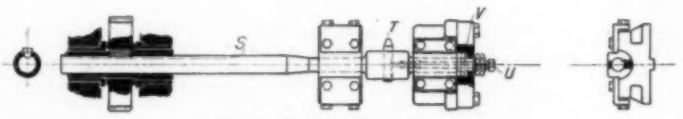



Fig. 6. Driving Train.




"THE ENGINEER"

Fig 8. Cutter Spindle.

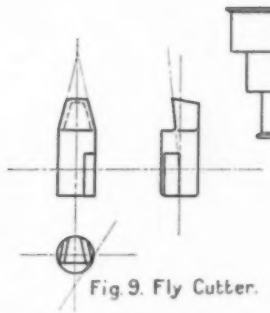


Fig. 9. Fly Cutter.

SWAIN Sc.

DETAILS OF SMITH AND COVENTRY'S NEW WORM GEAR GENERATING MACHINE

## Institution of Mechanical Engineers, North-Western Branch.

THE annual meeting of the North-Western branch of the above institution was held in the Memorial Hall, Manchester on Thursday, the 12th inst., Mr. Daniel Adamson occupying the chair in the absence of Mr. Charles Day. There were between seventy and eighty members present. Mr. Adamson announced the result of the elections to the committee as follows:—Messrs. J. Butterworth, H. Richardson and Professor G. Stoney, retiring members, re-elected on the nomination of the committee, together with two new members, Messrs. J. Bissett and W. Fox. Mr. Charles Day was re-elected chairman of the section for the ensuing year.

After the formal business had been disposed of Major Caldwell read an abstract of his paper entitled "Electric Arc Welding in Steel Structures." The paper was admirably illustrated by lantern slides, showing examples of welded steel buildings and other structures, notably the horse show stables at Olympia, a workshop roof at Brooklyn, foundry extension at Stoke-on-Trent, a factory at Tottenham, lattice poles and masts for overhead transmission and wireless aerials, pipe construction for hydraulic power installations and oil storage tanks. An abstract of the paper is as follows:—

### ELECTRIC ARC WELDING IN STEEL STRUCTURES.

In similar structures the cost of arc welding is decidedly lower than the cost of riveting, and the time taken in erection is also less. The operations are fewer and the whole work simpler. The transport of the material to the place of erection is also facilitated. The members of a roof truss or girder can be cut to length by the steel works, sent to the site bundled or loose, as may be convenient, laid out on the floor to proper marks or to a simple jig. The ends of the bars have to be chamfered, veed or cleaned before laying out, and are then ready for the welder. The actual welding takes less time than riveting and fewer men. If an electric supply is available on the site, the necessary apparatus for its control and distribution to the welders is simple and not bulky, rather simpler if the supply is alternating than if continuous. If there is no electric supply a portable welding set, consisting of a petrol or oil engine and dynamo has to be used. These sets are mounted on trucks so that they are readily shifted to follow the work. There is some saving in weight of the completed work, since it is generally possible to dispense with the gussets and palms required in riveted trusses. There is also less chance of error in assembling, as the welding is done whilst the members are lying in correct positions in the jig. Several jobs have been carried out in this country employing roof trusses of various types and spans. In every case it was found that the design was simpler than with riveted joints, owing to the absence of gusset plates, palms, &c., and not having to consider the requirements of riveting generally. The execution of the work was also very much quicker, for reasons above given.

In adopting a new process of this kind for any sort of structure the designer must have reliable figures for the strength of the joint, just as he must have reliable figures for the strength of the main material. A large number of tests have been made by the Admiralty, Lloyds, and by other independent testing establishments. These tests have been mainly on welds in mild steel of ship and structural quality.

A summary of test results to date will give some idea of the extent to which welds in steel structures can be relied upon. It should be premised that these are for mild steel of the usual structural qualities, and that the welds were made with flax-coated electrodes by various makers, intended for that material.

### TENSILE STRENGTH.

*Plain Butt Joints.*—The ultimate or breaking stress is equal to that of the original material. There is no greater range in the breaking stress of a number of test pieces, some with transverse butt joints and some unwelded, than there is in the breaking stress of a similar number of unwelded test pieces of the same material. In the majority of welded test pieces the fracture takes place in the original material, not in the weld, but as the weld metal is somewhat less ductile than the original material this may be due to a greater contraction of area in the original material. The results show that for purely tensile stresses arc welds can be relied upon as equal to the steel itself, and require no larger factor of safety in the design calculations. This is true for longitudinal as well as transverse butt welds.

*Lap Joints.*—These may be made with a full fillet on each side, or a full fillet on one side and a single run on the other, just to close the landing edge against the entry of moisture. Such joints when tested in tension experienced a certain amount of bending as the test piece tends to take up a straight line. The bending stress is most severe at the end of the overlaps. Double filleted joints generally break across the solid plate at the edge of one of the fillets at a stress of from 70 to 85 per cent. of the breaking stress of the plain plate. Single filleted lap joints generally break in two stages, first the closing run fails, after which the full fillet yields. Curiously enough, the breaking point is quite as high as with the double full fillets. The test is really a composite stress test, the actual stress in the material depending upon the proportions of the overlap and the length of the test piece between the grips of the testing machine. Tests made with treble-riveted lap joints of the same material give distinctly lower breaking stresses of between 60 and 70 per cent. of that of the plain plate. The riveted joints fail by tearing the plate through the line of an outer row of rivets where the bending stress is most severe.

*Elongation.*—As before stated, the weld metal is less ductile than the original mild steel, and necessarily the reduction of area is also less. The welded material breaks without much flow of the metal. The elongation in a transversely welded test piece may be only about 8 per cent., and the reduction of area about the same percentage of the original cross section, against an elongation of about 30 per cent. and a reduction of area of 40 to 50 per cent. for plain pieces.

*Crushing Strength.*—This item is not perhaps of much importance in structural designs, but it may have to be reckoned with in some cases, *e.g.*, where it is required to make up masts, &c., with joints in the vertical members. Professor Sir W. Abell gives some crushing test results in a recent paper. The welds were made at an angle of 45 deg. to the axes of the rectangular pieces joined, so that the shear strength in the welding material was tested as well as its crushing strength. The specimens were 4¼in. long, with a cross section of 2¾in. by 0.96in. Unwelded pieces of the same dimensions were also tested. The tests were carried up to 90 tons per square inch in

each case, and all the specimens distorted by bending at or before that pressure. None of them failed by crushing. The test was repeated on specimens of 3in. lengths by 1¼in. by 0.99in. cross section. These also bent and did not crush.

*Bending.*—Welded joints will not stand bending to the same degrees as mild steel. This is quite a logical result of the difference in the ducility of the steel and the weld metal. Professor Sir W. Abell, in the paper cited, bent plates of ¼in. to ⅜in. thick over a block having a diameter three times the thickness of the plates, taking care to bring the stress on to the deposited material. The fracture usually occurred through the centre of the weld. The ¼in. plates fractured at an angle of bend of 73 deg. to 87 deg., ⅜in. at 55 deg. to 68 deg., ½in. at 40 deg. to 48 deg. and 1in. plates at 13½ deg. to 27 deg. It did not make much difference whether the V of the weld was upwards or downwards. All were single V welds, though good practice would have made those in the ⅜in. and 1in. plates double V shape. It is clear that the angle of fracture decreases rapidly with the increasing thickness of the weld.

*Alternating Stresses.*—Endurance of alternating stresses is of very great importance, since all sorts of structures are subject to vibration and variations or alternations of load. Tests which give such alternation in a way which can be defined and compared with working stresses have been made in various ways. Professor Sir W. Abell used a modification of the Mohler test, in which the specimen machined to cylindrical form is rotated in a horizontal position with weights applied at such points as to give a definite bending moment, which is reversed at every revolution. The particular part of the specimens under test, in this case, including the weld, is reduced in diameter to concentrate the stress which can be calculated as a maximum fibre stress alternately tensile and compressive. The revolutions being counted, the endurance can therefore be expressed as a number of alternations at a certain stress. The welded specimens show a lesser endurance than unwelded specimens. This may be expressed by saying that they can endure a very large number, certainly several million, reversals of stress amounting to 6.5 tons per square inch, against about 10 tons for the unwelded specimens. Another form of test was used for flat plates, the ends of the specimens being firmly held whilst an intermediate point was raised and depressed by a definite amount. Lap-welded, butt-welded and riveted specimens as well as unjointed pieces were compared by this method. The results show that butt welds have an endurance of about 70 per cent. of that of the unjointed plates, whilst lap welds and riveted laps come out equal at about 60 per cent. of the endurance of the plain unjointed pieces

*Impact Tests.*—Lloyd's tests are two blows from a falling weight of 2 cwt. from a height of 9ft. on a ¼in. welded plate, and two of 4 cwt. from a height of 12ft. on a ¼in. welded plate, to produce no sign of cracking. These tests were easily passed with no sign of fracture. Professor Sir W. Abell gave particulars which show the amount of deflection and are more definite. The tests were made on ¼in. and ⅜in. plates each 5ft. in length by 2ft. 6in. in width, with a butt weld in the centre parallel to the shorter end. The plates were supported 15in. above the ground on angle bars parallel to the short edges. Four blows were given to the ¼in. plate, two with 1 cwt. falling 6ft. and 9ft., two with 2 cwt. falling from the same heights. The successive deflections were ⅞in., 1⅛in., 4⅛in. and 8⅛in. The blows on the ⅜in. plate were delivered with 3 cwt. falling 6ft. and 4 cwt. falling 9ft., 12ft. and 12ft. The deflections were 1⅛in., 4⅛in., 8⅛in. and 12in. respectively. In neither case did the welds show any signs of fracture. These tests dispose of any suspicion that the comparatively low ductility of the weld metal connotes brittleness.

*Modulus of Elasticity.*—These figures are of considerable interest for fundamental calculations. They are obtained in the usual way by tests on specimens made up entirely of deposited welding metal. In one case of tests made by Lloyd's Committee the specimens were strips 12in. long, 1in. by ⅜in. cross section, machined to size. The stress at the yield point was 19 tons per square inch, and the ultimate strength 29.6 tons per square inch, agreeing quite well with the tests made on welded joints. The modulus of elasticity of this sample was 12,900 lb. per square inch, which will be recognised as lying between the average figures for wrought iron and mild steel. Other tests have given rather higher figures. Professor Sir W. Abell found 11,500 lb. per square inch.

*Elastic Limit.*—Professor Sir W. Abell's tests indicate that below the elastic limit of the welded material the relation between stress and extension is practically equal to that of unwelded material. Beyond this point, as above indicated, the extension and reduction of area is less than that of mild steel or the ductility is lower. Also the elastic limit appears to be slightly higher. In the Lloyd's tests of deposited welding metal the yield point—which is not quite the same thing as the elastic limit—was 64 per cent. of the breaking stress.

A discussion of some length followed the reading of the paper. Mr. Daniel Adamson led off with a few introductory remarks, in which he expressed the opinion that electric welds were excellent in sheer and fairly good in tension, but that it was doubtful whether they should be used in situations subject to high temperatures. He thought that electric welding looked like effecting a revolution in structural work. It was very suitable for building up structures with the aid of jigs and tended to transfer work from the shops to the site on which a building was being erected. He remarked that the most interesting section of the paper was that which dealt with the welding of cast iron. Mr. Atkins contended that the use of jigs for structural purposes was impossible in the case of buildings having a number of various sections. He said that welded sections were more rigid than those that were bolted, and very rigid joints were not always desirable. Good welding required intelligent operators, otherwise there would be failures. He considered that more research work was required in connection with electric welding. Mr. Boswell also criticised the employment of jigs for building up sections. Mr. Gass referred to the difficulty of machining castings after electric welds, and said that grinding had to be resorted to. Mr. Fox warned the members present against the use of electric welding in connection with the corrugated furnaces of marine boilers, and did not look favourably upon the use of electric welding for ship structures.

Mr. A. Saxon said that his firm had not had the same success with electric welding as with acetylene welding for cylinders of steam engines and internal combustion engines. Mr. Sleigh asked for the author's experience of chemical action of acids on welds. Mr. Spencer said that he was not convinced that electric welding would quickly replace other methods in structural work, and that manufacturing on site was impossible. He regarded the testing of the building at Brooklyn referred to in the paper as impossible. Amongst other members who took part in the discussion, Mr. Reid said that there was a certain amount of uncertainty in connection with electric welding which would not be permissible for crane girders. As regards the repair of castings he had not seen one successful when the portion welded had to be machined afterwards, and he also thought electric welding was unreliable where the casting has to carry any load.

In replying to the discussion, Major Caldwell said he would be glad to supply figures regarding the costs of buildings illustrated in the paper which were cheaper and more expeditiously carried out than by ordinary methods. He said that electric welding was being used to a considerable extent in shipbuilding, and mentioned specially the conversion of tramps into oil-carrying vessels by electric welding the seams. He said that electric welding had undergone considerable improvement and that the metal used in the welds should be better than the parent metal. Regarding iron work, he said that pre-heating was essential, and advocated the use of an electrode which will deposit cast iron. With regard to structural work, Major Caldwell said that bolting required sixteen operations, whereas six processes were sufficient for welding. He added that the saving of metal effected in electric welding, compared with other methods, was owing to the absence of bolts and rivets, 20 per cent.

## PERSONAL AND BUSINESS ANNOUNCEMENTS.

MESSRS. JOHNSTON AND GILMOUR, 606, Eglinton-street, Glasgow, advise us that they are the sole representatives in Scotland for the British Rawhide Belting Company, Limited, London.

THE business hitherto carried on by the British, Irish and Colonial Department of the Ateliers de Construction Oerlikon has been transferred to Oerlikon, Limited, Oswaldestre House, Norfolk-street, Strand, W.C. 2.

WE are advised by Mr. William Stead, M.I. Mech. E., M.I.E.E., M.I.S.I., Duchy Chambers, Clarence-street, Manchester, that he has resigned the representation for the North of England of the Société Anonyme les Nouvelles Usines Bollinckx, Engineers, of Brussels.

ISLES, Limited, crane makers, Stanningley, Leeds, have recently appointed Mr. J. G. Clark, 12, Oxford-street, Manchester, as their Lancashire representative, and as their London, South of England and South Wales representative, Sir J. F. Payne Gallwey, Brown and Co., Limited, of London, Southampton, and Cardiff.

W. AND S. POLLOCK AND CO., 73, Robertson-street, Glasgow, inform us that they have purchased the Wellshot Brewery, Cambuslang, and are altering and extending it as an engineering works to take the place of their McNeil-street works. They also inform us that they have concluded arrangements under which their "World's Standard" crude oil engine will be manufactured in India by the Empire Engineering Company, of Cawnpore.

## EDUCATIONAL INTELLIGENCE.

A COURSE of lectures on "Waterways, Harbours and Docks" will be delivered at University College, London, by Dr. Bryson Cunningham, M. Inst. C.E., on Tuesdays and Fridays, at 4 p.m., beginning January 24th, 1922. The course is open to both members and non-members of the University. Further information may be obtained by application to Dr. Walter W. Seton, Secretary, University College, Gower-street, London, W.C. 1.

SPANISH INDUSTRIES FAIR.—The third Spanish International Industries Fair will be held at Barcelona from March 15th to 25th next. Information regarding it may be obtained from the Spanish Travel Bureau (official delegates for the United Kingdom), 11, Queen Victoria-street, London, E.C. 4.

MODEL ENGINEER EXHIBITION.—With reference to our description of some of the machine tools at the Model Engineer Exhibition, the Cheltenham Works, Limited, of 86, Acre-lane, Brixton, ask us to mention the fact that the lathe illustrated on page 42 is known as the "Super Relm," and not the "Cheltenham" as stated.

CONTRACTS.—The Underfeed Stoker Company, Limited, inform us that it has secured the following important orders during the past month:—Nottingham and Belfast Corporations, eighteen and twelve travelling grate stokers respectively; Tokio Exhibition, one travelling grate; and ash conveyors for Wolverhampton Corporation, State Electricity Commissioners, Victoria, N.S.W., and Kure Arsenal, Japan.

ANNUAL DINNER.—The fourteenth annual dinner of the staff and employees of Allen-Liversidge, Limited, was held at the Holborn Restaurant on December 23rd. Mr. Harry Stevenson, vice-chairman of the company, presided, and was supported by Messrs. Liversidge and Sprott, joint managing directors of the company, and by Messrs. Wettern and Rogers, directors, and numerous other guests. Toasts were limited to those of "The King," proposed by the chairman, and "The Company," proposed by Mr. C. J. Quirk, to which latter the chairman replied. After dinner a musical entertainment was provided, and the party, which numbered some 250, had a thoroughly successful and enjoyable evening.

LLOYD'S REGISTER OF SHIPPING: NEW OFFICERS.—The General Committee of Lloyd's Register of Shipping, at its meeting held on January 12th, elected Mr. J. Herbert Scrutton as chairman, Sir Thomas J. Storey, K.B.E., as deputy-chairman and treasurer, and Captain H. B. Hooper, R.I.M., as chairman of the Sub-committees of Classification of the Society. Mr. Scrutton succeeds Sir John H. Luscombe as chairman, the latter gentleman having expressed a desire to retire from office at the end of 1921. Among other recent changes on the Committee, it will be of interest to mention that Sir Alexander Kennedy, of the Fairfield Shipbuilding and Engineering Company, and the Northumberland Shipbuilding Company, and Mr. James Brown, of Scott's Shipbuilding and Engineering Company, have been elected to the General Committee in place of Sir Alexander Gracie, K.B.E., and Mr. James Denny, neither of whom sought re-election at the end of their term of office in December, 1921.

# Provincial Letters.

## THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

### Buyers "Holding Off."

IT does not appear that much business has resulted from the quarterly meeting of the Midland iron trade, on which a good deal of reliance had been placed, as affording a useful criterion for judging the future course of business in the iron, steel and engineering trades of the Midlands. Though there has recently been a good deal of inquiry, the main object was apparently to test prices. Without exception, quotations are still tending downwards. Consumers seem no more ready to buy than they were three months ago, notwithstanding the progress which deflation has made in the meantime. The quickening of inquiry of the past few weeks had encouraged hopes which have failed to materialise and very little new business is being booked. Consumers are evidently expecting further concessions to be made in prices, and until they are convinced that rock bottom has been reached business is not likely appreciably to expand. Some satisfaction is expressed by iron and steel masters at the cheapening cost of coal, of which one local colliery at least has lately made sales at as low as 18s. 6d. per ton. Coke prices also tend to fall. There is some encouragement arising from the placing of large orders, especially on foreign account, for constructional steel work. For grain elevators, involving about 6300 tons of steel for South Africa, local engineers competed, but the order has now been placed on the Tees-side, and it is presumed that the steel will be furnished from the steel works in that neighbourhood. These orders are encouraging the expectation of further business, as showing that prices have now got down to something like an economic basis, involving no particular risk to the purchasers.

### Pig Iron Prices Still Falling.

No further progress has been made in this district towards the re-starting of blast-furnaces, and those furnaces already operating are unable to dispose of the whole of their output. The Staffordshire smelters, as a rule, have decided that with the poor demand and the present heavy costs, especially under the head of railway rates, the outlook is discouraging. There is practically no demand for forge material, and foundry sorts are being called for only in small quantities. One local smelter estimates that the demand for pig iron is about 12½ per cent. of the normal. Prices continue to fall, and it is difficult to gauge one day to another exactly what forge material is commanding. Northamptonshire forge is now obtainable at £3 17s. 6d. at the furnaces and foundry at £4 7s. 6d. Derbyshire No. 3 foundry iron is quoted at £4 10s. and forge iron at £4. The further reduction of 10s. per ton made in Cleveland material, as reported by me in the "Latest News" column last week, has not affected this district very seriously, as the downward movement here has been more rapid, and there is no expectation that the North-Eastern makers will be able to compete in this district. The industry cannot afford to go on selling at these prices, it is urged, unless there is to be a considerable decrease in production costs. South Yorkshire coke is now commanding 17s. 6d. per ton, making the cost to the furnaces of supplies from South Yorkshire 25s. 9d., against 15s. before the war. There is a noticeable improvement in the tonnages of pig iron which are the subject of inquiry, some of these running up to lots of 1000 tons, and occasionally an inquiry relates to substantial export business. Cold blast pig iron is now to be obtained at £11 10s. f.o.r. The demand is increasing a little for this class of material, the heavy founders getting a little more business as the ironworks gradually get going. This trade is finding a little advantage from the improvement in South Wales, but the comparative idleness of the steel works has its sequel in the poor demand for rolls and auxiliary machinery.

### Competition in the Staffordshire Bar Iron Trade.

The Staffordshire manufactured iron trade is very badly off for business just now, and competition in the unmarked bar section is becoming more severe each week. Members of the Bar Makers' Association have for some weeks had to contend with competition from unassociated houses who have been underselling them at times even to the extent of £1 per ton. Now the Lancashire bar makers have entered the Midlands market in an endeavour to secure any little business there is to be had, and they are offering bars for the nut and bolt industry at 5s. below the local standard price of £13. It is no secret that Lancashire firms with business connections in Staffordshire have for some time been girding against the restrictions which have prevented their retaliating on the undercutting of firms outside the Association. Till last week, however, they stood by the agreement which forbade their quoting for the Staffordshire trade below the district basis of £13. Lancashire bars are, however, now on offer at £11 15s. per ton delivered Darlaston. Despite everything, however, the majority of makers of bar iron in this district take a more hopeful view of the future. Notwithstanding the unprofitable character of production, considerable energy is shown in getting business at whatever prices can be obtained. There is still a good deal of idleness at Staffordshire works, but encouragement is derived from the re-starting of the Shelton bar works at North Staffordshire. Continental competition has also to be reckoned with. Although Belgian bars for the bolt and nut trade can be bought for £9 12s. 6d. and £9 15s., the fact that, generally speaking, there is no delivery under six weeks is sufficient to prevent orders going abroad at a time like the present, when business is of a hand-to-mouth character to meet immediate needs. There is less activity in the galvanised sheet trade, with the inevitable result that competition has quickened, and values have declined to £16 10s. for export orders f.o.b. Liverpool. The home trade is flat, in keeping with the season.

### The Steel Market.

There is perceptible a slight improvement in the steel market and orders are slowly increasing. Prices, however, tend downward, and billets this week are somewhat lower in price than they were a week ago. They are now obtainable at £7 7s. downwards. Fierce competition has developed between the Scottish makers and those on the south of the border. Its effect is hardly perceptible here on account of the heavy railway rates. Steel bars are quoted at £10, as against £10 2s. 6d. for continental material. Foreign competition has now become unimportant in view of the very narrow difference between Belgian and English quotations. Several of the former received this week in Birmingham show prices varying only a few shillings from those of native makers. In such cases the home buyer invariably prefers the home-made steel. He has an additional inducement just now to do this, because of the very unsatisfactory deliveries from the Continent. In most cases British mills can give deliveries in a few days and sometimes even within a few hours of the receipt of the order. That the world is still hungering for steel and that railways everywhere are badly in need of reconstruction will be plainly seen when financial adjustments of an adequate kind have been arranged and something like stability has been restored to foreign exchanges, though it should be remembered that prior to the war our best customers for railway material were the home systems. The bareness of stocks of raw material has led to predictions of a boom later on in the year. If a buying movement developed it is possible there might be a rush for supplies in some directions, but consumers know it would be short lived. It is difficult to call to mind any department of industry in which the means of production are not greatly in excess of any probable demand in the near future.

### Staffordshire Tinned Sheets Reduced.

The Tinned Sheet Manufacturers' Association has reduced the price of Staffordshire tinned sheets by 2s. per hundredweight. This brings best charcoal to 60s. per hundredweight for 20 gauge, charcoal 58s. per hundredweight, and unassorted 54s. per hundredweight. Makers of lead-coated sheets fixed their price at 32s. per hundredweight for 20 gauge.

### Wages in the Engineering Trade.

Engineers in this district are much concerned at the moment over the question of the wages of youths and boys engaged in the engineering industry. The Engineering and National Employers' Federation—Birmingham and Wolverhampton area—has this week invited representatives of the various trade unions affected to a conference to consider whether the time has not arrived for a revision of the wages paid to boys and youths. It is stated that the earnings of women are likely to form the subject of a future conference. At present, however, only those of boys and youths are to be considered, and it is not the base rate, but the bonus, which is being discussed. The Wolverhampton Engineer Employers' Union, comprising eleven of the more important firms in the town, has given notice to terminate the wages agreement entered into with the youths and boys in March, 1921, with a view to a revision.

### Coventry Matters.

Little change can be recorded in the trade position at Coventry, though the unemployment returns show that the demand for labour continues to improve. The total number of wholly unemployed has dropped in a week from 10,525 to 10,390. The most gratifying feature is that the number of unemployed men fell from 8346 to 8088. A matter of considerable importance to all the motor and cycle firms is engaging the active attention of the Coventry Chamber of Commerce. This concerns the rates for the carriage of iron and steel sheets from Swansea. The disparity between the charges for Birmingham and Coventry from South Wales is so marked that local firms protest that it prohibits successful competition. The rate for 2-ton lots to Birmingham is 23s. 1d. per ton, against 34s. 5d. to Coventry, whilst for lots of under 2 tons the Birmingham figure is 39s. 8d. per ton, compared with 54s. 10d. for Coventry. The question is being raised with the London and North-Western Railway Company with a view to securing a reduction in the Coventry rates.

### Midland Unemployed.

I regret to have to record that an increase of 8400 is reported in the number of persons unemployed in the West Midland area. The increase is spread over almost all the manufacturing centres, but Coventry reports a slight improvement. There are now in the area 230,821 unemployed. There is an increase of 3000 on the Birmingham register and roughly 800 at Cradley Heath, 400 at Darlaston, and 350 at West Bromwich.

## LANCASHIRE.

*(From our own Correspondents.)*

MANCHESTER, Thursday.

### Iron, Steel, and Metals.

THE dulness in the iron and metal markets here is still unrelieved by any promise of coming activity. Every consumer one talks to is convinced that lower prices in iron and steel are inevitable, and one may picture them as sitting on the fence and watching the fall. There is business, of course, but mainly in small lots for immediate use. When any forward transaction takes place it is generally by a "bear" merchant who offers at considerably less than makers' prices; but there is not much of this, because there are very few consumers capable of being tempted by concessions. We have arrived at the end of the third week of the New Year, and if there is to be any new-year revival in trade, as was promised, we ought now to see signs of it; but there is nothing yet to induce idle works and blast-furnaces to start unless they are contented to begin working at a loss

### Metals.

The market for non-ferrous metals ought to be better off than the iron and steel market because the great slump in these prices took place in 1920, and only a very minor slump in 1921; whereas in iron and steel the great slump occurred in 1921, and we have 1922 for the minor slump. Nevertheless the revival in the non-ferrous metals industry is delayed and the markets have still a sagging tendency. Apparently this is the result of a fear that America will begin the expansion of production in copper before the conditions of trade warrant any such movement. There is also another possible reason, viz., that the official prices for manufactured copper and brass are not in accordance with the prices for the raw materials of the industry. This is perhaps the reason why the railway companies give out their orders in driblets, waiting for a more reasonable relationship between these prices. The demand for copper in this country is still very small compared with what it used to be when industry was in a normal condition; but it is said that the American consumption is growing to a certain extent, and Germany is a good consumer. The present prices for raw copper are low enough and the depression in trade cannot have much effect on them, but there is as yet no indication of a rising market, and "bull" speculation has not yet begun to show itself. The market for tin has been rather easy, but one has to realise that the drop since the middle of December has reached £9 per ton. This may mean that the previous "bull" speculation is liquidated, and that another movement of the kind may be started shortly. Possibly, however, the "bulls" will wait a little to see how consumption develops. At the moment the latter is small, but the cessation of buying during the last fortnight may mean that a revival is near at hand. In lead, the position is fairly steady, although prices have been slightly easier. The stocks here had become rather too small for safety, but the belief is that the danger of scarcity is now passed. Australian lead will soon be coming in and will tend to make the consumer safer. Spelter is practically unchanged, and German supplies are still held back.

### Pig Iron.

The demand here for foundry iron remains negligible, the reason being that there are very few orders for castings to be obtained. The prices seem a little irregular because, although the reduction of Cleveland iron to 90s. per ton does not affect this market directly, it has an indirect influence on Midland pig iron makers and renders them more anxious to sell. Buyers here, however, if any were disposed to place orders forward, could probably do better with some speculative merchant than with a maker. This seems to be particularly the case with regard to Scotch iron; although no doubt for a large contract over the next six months, some merchants would accept low prices for common iron. The Cleveland makers will be able to resume their business with Scotland now that the cost of the iron delivered there is no more than that of continental iron (if so much) and this business will probably delay any further reduction in the price for a time. A few more furnaces are being put into blast, and one notices that this is being called "a revival" in the iron trade. It is very doubtful, however, whether such a description is justifiable. At any rate, there is no sign of revival here: quite the contrary.

### Finished Material.

The prices for finished steel are still very irregular. Some outside firms have evidently been taking low prices for export in order to keep going; but what is wanted for this business is that the rise of pig iron on the Continent should be followed by a rise in the prices for finished iron and steel. There is no really profitable manufacturing business yet in this branch of the trade.

### Scrap.

The market here for scrap is dead, but there is not much change in prices except that heavy steel melting scrap is very low. It is said that 45s. per ton is as much as can now be obtained for this material. Some of the ironworks are paying up to £3 10s. for good heavy wrought scrap, but others will give only £3. Foundry scrap ranges from £4 5s. to £5, according to quality, but there is no demand.

### Engineering Society Meetings in Manchester.

Manchester engineers who have a penchant for technical papers and discussions were able to regale themselves to the full last week at the meetings of the various technical societies. The North-Western branch of the Institution of Electrical Engineers led off on Tuesday with a paper on "Telephone Line Work in the United States," by Mr. E. S. Byng. This was followed on Thursday by the Institution of Mechanical Engineers' North-Western branch meeting, when Major Caldwell read his paper on "Electric Welding," and on Friday the Manchester Association of Engineers, not to be outdone, followed suit with a paper by Sir Henry Fowler on "Works Management." It would seem ungrateful to utter a word of complaint after such a feast, but I would most cordially recommend the energetic local secretaries of these various institutions to get together before the next winter session comes round and endeavour to arrange their meetings in such a way that they do not all fall in the same week quite so frequently. Such co-ordination would, I am sure, be to everybody's advantage, and the attendance of members would be larger in consequence. While in a complaining mood, I might take this opportunity to urge upon the proprietors of the hall, where two of the above societies hold their meetings, the desirability of providing some more adequate heating apparatus. All Englishmen love an open fire, but even two such fires are far from sufficient for a lofty hall capable of accommodating several hundred persons, especially with a notice always prominently in view that "Smoking is Prohibited." Manchester is very "hard up" for halls suitable for meetings, otherwise I could not imagine gatherings of engineers being held under such uncomfortable conditions during the winter months. It is to be hoped that when the Engineers' Club carries out its new extension scheme during the present year the committee will be able to offer hospitality to the institutions to which so many of the club's members also belong. Should this not always be possible perhaps some more comfortable building can be obtained for these meetings.

### An Optimistic Cotton Magnate.

Pessimism being such a prevalent epidemic it is refreshing to come across a leader of industry who can be described as an optimist. Such an one, however, exists in Lancashire in the person of Sir Charles W. Macara, one of the leaders of the cotton industry, who, writing recently on the trade outlook, says he considers that the future may be faced with cheerfulness and confidence. He says that before many months are past Lancashire will have almost forgotten her present troubles in abounding prosperity; that it is to this country that India as well as China and other great users of cotton goods will be obliged to come if their teeming millions are to be clothed. Sir Charles says that through depreciation and destruction during war time the cotton trade must be wanting as many as 30,000,000 spindles to bring it up to the productive capacity we had before the war. Lancashire, says Sir Charles, will want between 300 and 400 more mills to make up for what has been lost, and she will be a rival with India for the services of the already overburdened textile machinist. He says the recapitalisation of the textile industry a year or two ago has been its salvation, and does not think that the prices paid for the mills are too high, for the buildings and machinery could not be replaced to-day for double the price paid. Although there are certainly grounds for much of Sir Charles' optimism, it must not be forgotten that there is not likely to be a boom until the prices of Lancashire staple products show a considerable fall, of which there is at present little sign.

BARROW-IN-FURNESS, Thursday.

### Hematites.

There is no material change to note this week in the general condition of the hematite pig iron trade of this district. Not much business is being done and any improvement, it is expected, will be gradual. There is plenty of work held up for the reason that lower rates are demanded, and it may be there will be a further cut shortly. In the meantime the production remains small, with a total of only six furnaces in blast for the entire district, three in North Lancashire and three in Cumberland. The demand on the part of local steel makers accounts for a good part of the Barrow output.

### Iron Ore.

In the iron ore trade there is a little more activity, but the mines at Hodbarrow and Park remain idle, the pits engaged being at Yarlside, Newton and Roanhead and in the Egremont district.

### Steel.

The steel trade presents no new features this week. The cuts made last week in prices may induce a fuller business, but that remains to be seen, as buyers are very cautious. Rails and hoops are being rolled at Barrow, and some of the other departments are engaged. A further importation of steel billets for hoop making is noted from Caen in France.

### Shipping.

The shipping trade is quiet. Last week two small cargoes of pig iron left Barrow for Antwerp and Treport in France. The importations of oil into Barrow are fairly good.

### Shipbuilding and Engineering.

On Tuesday, Vickers, Limited, launched from their naval construction works at Barrow the steamer Jervis Bay, built for the Commonwealth Line. She is similar to the Moreton Bay and Hobson's Bay, also built at Barrow for the same line. They have a length of 548ft. and a displacement of 23,320 tons. The engines are of the double-reduction geared turbine type and the speed is 15 knots. The Moreton Bay has just completed her first trip to Australia and the Hobson's Bay is almost completed.

## SHEFFIELD.

*(From our own Correspondent.)*

### Conflicting Views.

THE situation in the local steel and engineering trades is somewhat uncertain at the time of writing. Some of those best qualified to judge trade tendencies still speak hopefully of the prospects, and indeed point to an increasing number of inquiries, and even to orders being placed rather more freely, though still disappointingly small in bulk. On the other hand, the pessimists point to the tell-tale Employment Exchange registers, which show an increase of 1500 as compared with the weekly average total since Christmas. Of the 47,500 now returned, 7000 are on short time and all the rest are totally unemployed, and of this number only 3000 are under eighteen years of age. There is nothing in particular to account for the increase last week, and it can only be attributed to less trade. It is certainly a very discouraging relapse after the slightly more promising figures of the first week of the year. On the other side of the picture there is a little satisfaction to be drawn from the fact that Cammell Laird and Co. have received an order from Alfred Holt and Co. for an 11,000-ton twin-screw turbine composite cargo and passenger boat for their Far Eastern trade. The news is, of course, of more immediate concern to the Birkenhead district, but Sheffield will receive some of the fruits in the shape of forgings and other parts, and while the order will not go far to compensate for the cancelling of the battleship orders—which immediately threw an additional 10,000 men idle in Sheffield—it is not to be despised in these days. Perhaps even more than the immediate work it provides

it is gratifying as indicating a renewed confidence on the part of shipping concerns.

### A Reorganisation at Vickers.

A great deal of interest has been occasioned in this district by the announcement that Sir George Buckham is about to take up residence in Sheffield, the inference being that this fact foreshadows important developments in connection with the direction of affairs at Vickers' River Don Works. Sir George Buckham, who is one of the greatest authorities on ordnance in the country, has been connected with Vickers Limited since 1895, for some years past as chief ordnance designer and as a director for about five years. He received his training at the Elswick Works of Sir W. G. Armstrong, Whitworth and Co., Limited. It may be recalled that at the annual meeting of Vickers' shareholders a month ago Mr. Douglas Vickers, the chairman, announced that one consequence of the decisions of the Washington Conference would be that the services of many of the firm's expert staff would have to be dispensed with, and that others would be removed to Sheffield and Barrow. It is understood that Sir George Buckham is bringing to Sheffield a number of his own staff and assistants, though to what particular new line the local branch of the great armament works is to be applied has not yet been disclosed. There are, however, rumours that the resources for the manufacture of big guns will by no means be scrapped.

### Stainless Steel Competition.

Another interesting announcement of the past week is that litigation is pending in the American Courts relative to patent rights in the manufacture of stainless steel. About four years ago the American Stainless Steel Company was formed. This powerful combination of about eight or ten of the biggest steel firms in the United States purchased the Firth-Brearley patents from the parent English syndicate. The latter is not directly concerned in the proceedings, but Mr. Harry Brearley, the inventor of stainless steel, is now on his way to America to give expert evidence in the proceedings, which are directed against the Ludlum Steel Company, for alleged infringement of the patents. In the comparatively short time since stainless steel was introduced in America it has made remarkable strides in public favour, though the applications of the product are still, I am told, on a more restricted scale than in this country. A great many Sheffield firms are now making stainless steel or utilising it in the manufacture of finished articles, and almost every week one hears of some new use to which it is being applied. Sheffield manufacturers still send over a very considerable volume of stainless steel articles to America, and they will watch with keen interest the attempt to create something like a monopoly in the manufacture.

### Municipal Engineering.

Various aspects of the Sheffield Corporation's engineering works have been figuring somewhat prominently in the public attention during the last week or so. Memories of the great Sheffield flood of sixty years ago were revived by the bursting of a dam at Bradfield, the scene of a more serious flood of the 'sixties. The dam was constructed of concrete blocks and a section about 20 yards long and 20ft. high was carried away by a torrent of water for a distance of between 30 and 40 yards and eventually deposited upright in the bed of the river Loxley. The dam was part of a scheme recently adopted for pumping water back from the city to Low Bradfield, whence it is discharged into the river Loxley. This small reservoir had a capacity of five million gallons and had only been completed about three months. It is part of the ingenious scheme whereby sewage water, after being purified, is sent back into the river as compensation water for the millowners, thus saving the city the expense of a large new collecting reservoir that would otherwise have been necessary. Mr. William Terrey, the general manager and engineer of the waterworks, attributes the mishap to the sudden and excessive rainfall since Christmas following the prolonged drought of the summer and autumn months. These conditions doubtlessly caused a subsidence, which in turn led to the base of the wall tipping up. At the first onrush of water the flood rose to a considerable height, carrying with it a great mass of stones and *débris*. Everything in its course was swept away and the occurrence at once started wildly exaggerated reports of another "flood." Fortunately, in the present case no lives were lost; in the mishap of 1864 the death roll totalled 240. Another piece of municipal engineering which has been completed during the past week is a fine new boulevard, 2000 yards long and 80ft. wide, which opens up a famous piece of woodland and has been compared with one of the famous drives through the Dukeries. The road has cost £48,000 and has provided work for a considerable number of unemployed, during a particularly necessitous period.

### University Stimulates Mass Production.

It is certainly not the fault of the Applied Science Department of Sheffield University and its distinguished head, Dr. Ripper, that, as reported in my notes last week, the Sheffield cutlery trade is so conservative in its attitude towards mass production methods and the application of automatic machines to many of the processes to which they are suited. The technical societies which have been formed and fostered under the direction of the Department have just re-started their session, and at the opening meeting Mr. W. H. Bolton, who has been specially entrusted by Dr. Ripper with this branch of the University's activities, addressed the Cutlery Trade Technical Society upon the progress of cutlery manufacture. Mr. Bolton pointed out that at least three American armament firms had now entered the field of cutlery production, and it was, he urged, more than ever necessary for the Sheffield industry to adopt modern engineering methods. He announced that in order to assist in this desirable end the Department of Applied Science of the University had designed a special grinding machine for grinding pocket knives, piston rings, circular saws, and a variety of other articles on mass production lines. The machine was fully automatic in its action, and one operator, said Mr. Bolton, could grind one gross of blades or two circular saws at one operation. The machine is shortly to be deomnstrated before the Sheffield cutlery makers. Last evening—Thursday—the Cutlery Technical Society discussed foreign competition, more particularly with relation to file manufacture.

### Pit Cage Safety Devices.

A shaft accident at a colliery near Sheffield, in which two men were killed as a result of a descending cage becoming detached from the rope, has once again directed attention to the need for more effective safeguards against this danger. One or two local inventors have been asserting the claims of their devices, while other experts contend that in view of the speed at which the cages travel it is practically impossible to provide any certain means of arresting the fall of the descending cage in the event of the rope becoming detached. The sudden arrest of the cage, it is asserted, imposes too severe a stress on any mechanical attachment, while any attempt to bring it to a gradual stoppage would generate such intense heat by the friction on the guide ropes as to render this method equally impracticable. It is maintained that a downgoing cage can never be adequately protected on account of the impracticability of providing guide rods or ropes hundreds of yards in length of sufficient cross section to withstand the shock of suddenly arresting weights of 20 tons or more, which normally are travelling at anything up to 50ft. per second. In the present instance the accident was not caused by overwinding—against which the protective devices seem to be more effective—but the descending cage "drew the capping off the rope," according to an expert. The winding rope is attached to the cage by means of a capel round which are bands of iron to hold the rope in the grip of the capel. By some means the rope slipped out of the capel and the cage was precipitated to the bottom of the shaft.

### The Coal Position.

The inland consumption of industrial fuel since the holidays has not been on a particularly heavy scale. In many cases it is not so heavy as it was before the holidays, and while there is a general expectation that conditions are going to improve, the process must necessarily be a very slow one. The demand for export from this district is also on a very restricted scale. This fact is largely to be attributed to the severe competition from Tyneside collieries, where rates to ports are substantially lower than from here. Unless there is a material improvement in the demand for inland and export coal during the next week or so it is certain that many collieries will be compelled to work short time. Already there are some very large stocks on load, which are daily increasing. As a result there is a considerable amount of selling pressure and special lots from stocks are obtainable at low rates. In spite of the suggestions from certain quarters that coal prices are still fabulously high, so far as this district is concerned, such remarks cannot apply, as in many cases industrial undertakings are buying their fuel at from 10s. to 12s. per ton lower than the prices that were in operation at the end of last March. The severe amount of competition that is in evidence for any business that is passing is in itself sufficient guarantee that, at any rate, pithead prices are being reduced; in the same way competition between merchants and factors has resulted in their having to cut margins of profit down to what are now practically pre-war figures. The demand for gas coal is not quite so active as it was before the holidays. This result usually obtains with the turn of the year, and is caused by works using up their reserve stocks and so reducing current deliveries. This particularly applies now, following the very high prices which many gas concerns were called upon to pay for their reserve stocks which were put down in July and August last year. The general position of the small fuel market is very unsatisfactory, especially so far as low-grade qualities are concerned. In the first place, this fact is attributable to the comparatively small number of blast-furnaces that are in operation, and until a largely increased number are put into blast it is very difficult to see how there can be any real improvement in the small fuel market. In the second place, in some cases there are large stocks in evidence and selling pressure is more or less general, the question of price being in many cases a very secondary consideration to that of disposing of or reducing stocks that are under load. The demand for blast-furnace coke is not nearly so active as it was a short time ago, when the export position was considerably stronger. There is, at the moment, practically no demand for export, and as a number of furnaces have been damped down the production of coke is not moving very freely.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

### Trade Gradually Reviving.

THERE are not wanting signs of a slow, but nevertheless welcome, revival in trade in the North of England. In the pig iron industry the position has improved considerably. Two furnaces at the Skinningrove Ironworks, which have been idle since the coal strike last April, have been put into operation once more, and an additional furnace has also been "blown in" at the Thornaby Ironworks of Whitwell and Co., Limited. Bolckow, Vaughan and Co., Limited, Middlesbrough, also propose putting in a furnace for the production of ferro-manganese. The iron ore mines at Skinningrove, owned by Pease and Partners, which supply the local furnaces, have been reopened.

### Experiments with Liquid Air Explosive.

Important experiments with the object of proving the effectiveness of liquid air as an explosive have been carried out in the Cleveland ironstone mines and Weardale limestone quarries during the past few days. The experiments were witnessed by mining engineers from all parts of the country, and H.M. Inspector of Mines for the Northern Division. In using liquid air much the same methods are employed as with powder. For the blasting operation a hole is drilled into the rock, and into it, instead of the powder and pellets now used, is put what is called a cartridge, which has been soaked for about ten minutes before in liquid air. The composition of the cartridge is a secret jealously guarded by the manufacturers. A time fuse is used to cause the explosion, and apparently the preparation which forms the cartridge acts, when the fuse is applied, as a medium for instantaneously gasifying the liquid air. By itself the cartridge is perfectly harmless. It can, in fact, be broken without any possibility of danger. The much greater safety ensured in handling the new explosive, as compared with the old, is one of the important advantages it offers. Another benefit which, it is claimed, is derived from its use, is that it causes very little smoke, and there is an entire absence of noxious fumes. In the experiments in the Cleveland mines a slight difficulty was encountered in gauging exactly how much material was equivalent to the charges of blasting powder which would have been needed for the purpose in view. The object is not to shatter the mineral, but merely to apply sufficient force to detach the required ironstone from the strata. Experience should quickly remove the difficulty with the new explosive. The experiments were regarded as being very satisfactory. The opinions formed by the Cleveland mining engineers are to be reported to the mineowners.

### Cleveland Iron Trade.

The re-starting of several more furnaces in the Cleveland district may be regarded as a direct outcome of the improvement in the outlook for the pig iron trade. The expansion of business following on the price cuts made last week has not, however, attained anything like the dimensions hoped for, and such trade as is being done at present is almost entirely on home account. There are a fair number of inquiries from foreign consumers, but prices are still regarded as too high, and it would appear that further reductions will be necessary before the lost overseas trade can be recovered to any extent. Still, on the whole, there is more business being done in Cleveland pig iron, and there are indications that it will improve. Prices are maintained at 95s. for No. 1 and siliceous iron, 90s. for No. 3 Cleveland G.M.B., 87s. 6d. for No. 4 foundry, 82s. 6d. for No. 4 forge, and 80s. for mottled and white.

### Hematite Pig Iron.

Although good sales of East Coast hematite pig iron have been made, competition for orders is very keen. At present, 97s. 6d. is still the nominal figure for mixed numbers, but buyers are not prepared to pay that price, and for reasonable quantities sellers are quite ready to meet them in the matter.

### Iron-making Materials.

Consumers of foreign ore appear to have covered their immediate requirements, and are disposed to await developments. At all events the recent buying movement has ceased, and the market is idle with best Rubio ore nominally at 26s. 6d. per ton c.i.f. Coke prices are inclined to droop. Good blast-furnace coke has been sold at 27s. per ton delivered at the works, but that seems to be a top figure, and other quotations range from 26s. 6d. per ton.

### Manufactured Iron and Steel.

The manufactured iron and steel trade is very slack indeed. Buyers still appear to be holding off in the hope of reductions, but if so, makers assert that they are doomed to disappointment, as even present prices do not cover the cost of production, and farther concessions are remote. Still, it is a fact that makers are cutting prices still farther for foreign orders, though they adhere to the fixed minimum prices for home business, these latter being unchanged.

### The Coal Trade.

The Northern coal position is giving signs of actual and prospective improvement. The recent heavy arrivals of tonnage have braced the market quite perceptibly for all business for the rest of this month, and with loadings now proceeding actively, there is fuller working at the collieries in the North. After meeting their commitments, collieries have very scanty supplies available for spot trading, in consequence of which prices are fairly stiff, but through second hands small quantities can be obtained at rather lower figures for both spot and farther ahead. The forward market is, however, rather slow. There is no lack of inquiries on the market, both for home and abroad, and these inquiries are very active at the moment, but in the main the actual bookings are small. Most of the large exporting firms are quite hopeful as to the future possibilities of the trade, but until there has been something like a stabilisation of values foreign buyers will continue to operate for the very minimum quantities from week to week, in order to benefit immediately from any favourable alteration in the market. The Northumberland steam coal section is fairly active for spot, and producers are able to realise their full quotations in most cases for screened sorts. Steam smalls are not so steady as they were. Larger production, which ensures fuller supplies, tends to deflate the spot values, which are gradually coming down. Durham gas coals are moderately steady for early shipment, but there is no appreciable pressure for forward dates, and values are not very well assured, though for the time being the position is satisfactory. The bunker coal trade is better than it has been for some considerable time past. The position with regard to coking coal has improved, but there is still room for further development. The coke market continues to drag. Supplies of every kind are available, but the volume of business transacted is not very large.

### Foreign Competitors Beaten.

It is interesting to learn that Ashmore, Benson, Pease and Co., Limited, gas plant manufacturers and engineers, of Stockton-on-Tees, have had their tender accepted for a large contract for the Toronto Gas Company. The order is for a big installation of gas purifiers, and has been secured in face of keen competition from America.

## SCOTLAND.

*(From our own Correspondent.)*

### Little Improvement.

THE general industrial situation has not changed appreciably since the turn of the year. Markets have shown little movement, and there are few signs of renewed activity. A number of works may restart this week, but anything approaching a general resumption is not expected. Producers still hope for a reduction in rail charges, which they contend would soon lead to increased business on all sides. In the meantime Scottish manufacturers are not able to meet competition from across the border, where railway charges have been reduced, thereby cheapening the cost of raw materials and fuel as well as the final cost of delivery to the consumer. Various rumours are abroad, however, and a change for the better is fully anticipated within the next week or two.

### Notable Motor Ship.

Representatives of the shipbuilding and allied industries were present at the trials of the new motor ship Pinzar, which were successfully carried out on the Clyde on Saturday last. This vessel, built by William Beardmore and Co., Limited, has been equipped with a Beardmore Tosi-Diesel engine. The Pinzar is a single-screw vessel of 2050 tons deadweight, 240ft. in length, 38ft. beam, and 18ft. in depth. She is designed particularly for the Spanish fruit trade of Messrs. MacAndrews of London. The trials gave great satisfaction, the speed attained being between twelve and thirteen knots. A feature of the vessel is that no boiler whatsoever is installed. All auxiliary machinery is electrically driven. It is claimed that this vessel can carry 1000 tons of cargo for a mile at an expenditure of less than one shilling in respect of fuel and lubricating oil.

### Steel and Iron.

The past week was more or less one of inaction so far as steel and iron were concerned. The lack of orders has induced manufacturers to prolong the time of stoppage and few works showed any signs of life. Some steel works will restart during the present week, and others are to be re-opened within a week or two. One concern which has been idle practically for twelve months has intimated the probabiltiy of an early re-start with a prospect of fairly steady employment for some time. It is hoped that this is an indication of better times all round. At any rate, furnaces are being re-started at another establishment in the same district. A rumour has been in circulation concerning the shipment of Scotch billets to Belgium, and though considerable doubt existed as to the authenticity of the rumour there appears to be some truth in the statement. In any case it is said that Glasgow merchants have had further inquiries, not only for steel billets, but for blooms also. It was said that the shipment in question was one of 2000 tons of Scotch soft billets (2in.) at a rate of £7 15s. per ton c.i.f. Generally speaking, there has been little change in prices of late with the exception of that of pig iron.

### Coal.

The activity in the Scotch coal trade is still of a very one-sided nature, being chiefly confined to the export department. Land sale business has lagged for months now, and there is very little sign of any change for the better. The industrial demand has long been almost at a dead-end, and only on occasion has the household trade been anywhere normal. Home business has been chiefly made up of sales to railways and municipal concerns. Round coal is being neglected and collieries in some districts are feeling the pinch, and miners are only getting from two to three days' work per week. This is the case particularly in certain districts in Ayrshire. Lanarkshire is somewhat better, but the Lothians and Fifeshire are reaping most benefit from the improvement in the export trade. In all districts, large sizes of nuts form the chief source of demand, and now an improving tendency in smaller sizes can be detected. Inquiries for these are fairly steady and prospects are good. The price of household coal is falling, and in some districts a good quality can be secured for 2s. per cwt., showing a reduction of 6d. per cwt. within a week or two.

### Hard Times for Miners.

In some districts in Ayrshire employment is scarce in the coal trade, and considerable hardship is reported. Instances have been mentioned of miners having only earned 10s. during a week. Some men had only one day's pay, others one and a-half day's and some two days in the week.

### Restarting Steel Mills.

I understand that the Lanarkshire Steel Company, Limited, the well-known steel-making firm of Motherwell, has decided to resume work in its mills in the course of the next two or three weeks. In view of the enormous amount of unemployment which is at present prevailing in Scotland, this is welcome news, as it will mean that a large number of men will be engaged. In normal times, the Lanarkshire Company employs something like 2500 men, and although it will not, I gather, be possible for that number to obtain immediate employment, it is thought that a good proportion will be taken on.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

### Coalfield Troubles.

THE outlook from the labour point of view in the South Wales coalfield is still somewhat obscure, and trouble appears to be simmering beneath the surface, due to the fact that the earnings of the miners are not large enough to make for the comfort of the workmen. Employers recognise that for things to be in a healthy state wages should be on a level that will bring about satisfaction. Better results under such circumstances should be obtainable, but unfortunately the industry cannot afford to pay higher rates. The owners are losing money, and improvement in trade is not perceptible. The conditions all round leave much to be desired, and it is only by artificial means that the position of labour can be improved. But bad as are the conditions, the situation cannot be bettered by drastic measures on the part of the workmen, and to talk of fighting to improve their lot is only calculated to make things much worse, as trade is bound to be adversely affected and buyers abroad will immediately there is a sign of trouble brewing look for their supplies to a quarter in which they know that they will be sure of securing the delivery of coals. Thus it is unfortunate from this point of view that the President of the South Wales Miners' Federation should persist in his attitude of fostering strife and publish it abroad that he "welcomes the wholesome revolt which is spreading throughout the coalfield." Such a statement may do an incalculable amount of harm to business, which is a long way from being what may be termed active.

### Ebbw Vale Dispute

Up to the end of last week grave fears were entertained that work at the whole of the Ebbw Vale Company's collieries, and possibly the allied undertakings, would be brought to a standstill owing to the strong feeling that prevailed among the workmen regarding the alleged treatment meted out to them and their assertions that the Minimum Wage Act was being ignored by the officials. Fortunately, however, as the result of negotiations between the men's representatives and Mr. F. P. Hann, the general manager, the differences have been adjusted and work continues. According to the men's agent, Mr. Evan Davies, the general manager, has given an assurance that incivility on the part of any colliery official towards any workman would be summarily dealt with, while the most serious point in dispute, viz., the alleged non-payment of minimum wages, had been cleared up. Mr. Davies pointed out that the men were not without their faults, and they must do their duty, but it had been agreed that where a man was working in an abnormal place at a colliery he should at once go to the colliery manager, and if his claim was disputed he should take his case to Mr. John, an official of the company, but if he also disputed the claim, then the men had the right to call in an independent man to decide the issue. Mr. Hann had also agreed that Clause 13 of the national agreement must apply, and that men would go back to their proper places. Altogether, the terms appear to be very satisfactory, and if carried out in the proper spirit there should be no trouble in future at these collieries.

### Dock Charges and Facilities.

The general committee which is dealing with the question of rail and dock charges on behalf of traders met this week, and at the close it was announced that the Bristol Channel Dockowners' Association was prepared to make further reductions in non-statutory charges as and from the 16th inst. if they were accepted as a settlement. These proposals set forth that in the case of screening coal at shipment the charge should be 8d. per ton, as against 1s. 1d. per ton; that siding rent on wagons awaiting hire should be 9d. per wagon per day after three clear days, excluding Sundays; while other reductions were made affecting the special delivery of ships' stores and their shipment, and the tipping and weighing of traffic other than coal. The Association stated that it was not prepared to make any further reductions in statutory charges. The Committee considered the proposals of the dockowners, and has replied to the effect that the concessions now offered with regard to non-statutory charges only afford very slight relief, and cannot be accepted as a final settlement, but the trade has been advised that the modifications were to come into force as and from the 16th inst. The Committee points out that the reductions made can in no way be considered by the trade as a satisfactory solution, as many of the charges are a serious handicap and tend unduly to embarrass the trade. The Committee is of opinion that the reductions in the statutory charges have not been commensurate with the improved shipping trade which the dock companies have enjoyed in recent months, the export trade (excluding bunkers) having increased by 60 per cent. as compared with 1920. The concessions made by the dock companies are only equivalent to about 27 per cent., notwithstanding the increase in shipments, reductions in wages, and in the cost of coal, stores, &c. The general committee has therefore suggested to the dockowners that a further joint meeting be held, as the trade would prefer to arrive at a friendly solution if possible of the present difficulties.

### Tin-plate Bars.

The South Wales Siemens Steel Association decided at its meeting held last week to reduce the price of steel tin bars by 7s. 6d. per ton, thus bringing the price to £7 7s. 6d. Wages of tin-plate and Siemens steel workers, so far as the bonus is concerned, are based on the price of the steel tin bar. The wage reduction of the scale in the case of the tin-platers holds at £7 10s., but the present wage is based on the ascertainment of £8 5s. per ton. Thus it is expected that the next ascertainment will show a reduction of wages so far as the scale is concerned, but seeing that the employers have granted 10 per cent. on the wages based on the steel bar price of £8 5s. per ton, it is assumed that the existing bonus will hold. As regards the steel sliding scale, this goes down to £5 per ton, but it will be remembered that the steel masters granted 3s. per week to the men earning 30s. and under, while the present conditions of low-waged men on existing wages are so adverse that it is scarcely thought that wages can be reduced further.

### Patent Fuel Workers' Wages.

Repesentatives of the South Wales and Monmouthshire Patent Fuel Manufacturers' Association recently met the representatives of the workmen to consider the application of the former for an all-round reduction in wages of 30 per cent., representing 6s. per day to men employed on day rates, but in view of the fact that rates had been reduced by 20 per cent. since August last, and that the Ministry of Munitions bonus of 12½ per cent. had been withdrawn, it was agreed to defer consideration of the claim for a month. As a matter of fact, the last of the decreases only became operative as from the 1st inst.

### Swansea and District Works.

It is reported that each of the Swansea spelter works will be assisted by the arrangement made with the Board of Trade under which British smelters are to be supplied with Australian zinc concentrates on special market terms. Arrivals are due at Swansea, and will average 8000 tons per month. This quantity is insufficient to keep all the furnaces going at the various spelter works, but it will result in more being put into operation, and the Swansea Vale works are lighting up two more furnaces this week. The announcement is also made that the Whitford steel sheet galvanising works at Briton Ferry were to make a re-start on Wednesday this week, thus giving employment to many workmen. These works have been idle for some weeks.

### Current Business.

So far as can be seen, there is practically no change to record in the state of the steam coal market this week. Prices are on the whole fairly steady, but this is for the reason that colliery owners will not reduce their prices appreciably, and prefer to stop the running of their property than increase their losses by accepting lower figures. The docks are pretty well supplied with tonnage, and complaints are still made that delays are incurred in getting loading berths. This, naturally, reacts on the collieries, which are frequently in difficulties for empty wagons, because they cannot get their coals tipped promptly. All this, of course, points to the necessity of action being taken to remedy the existing conditions of work at the docks, thus permitting of better facilities. Best large steams can be obtained at 24s. 6d., and other Admiralty large qualities at 24s. Best small steams are firm at 18s. to 18s. 6d. Anthracite coals, with the exception of machine-made nuts, are a weaker market. This is more especially the case with large coals. Patent fuel ranges from 24s. 6d. to 27s. 6d., foundry coke is 32s. 6d. to 37s. 6d., and pitwood is 29s. to 30s., importers preferring to bank supplies rather than accept lower figures.

# Latest News from the Provinces.

## WALES AND ADJOINING COUNTIES.

### Swansea Metal Exchange.

THE tinplate market is easier as a result of the inquiry falling off, and stocks are consequently accumulating. It is not improbable unless the demand improves, that some mills, which have only recently re-started operations, will have to suspend working again. Welsh bars are now quoted at £7 7s. 6d., the reduction of 7s. 6d. being due to cheaper pig iron.

### New Dry Dock.

It is announced that the Swansea Harbour Trust has completed arrangements for the leasing of a large tract of land near the entrance to the King's Dock for the purposes of a large dry dock. It is understood that the Jarrow Shipbuilding Company is the firm interested in the construction of this dry dock, which is to be taken in hand immediately. A site for a second dry dock has been reserved for future possibilities.

## SHEFFIELD.

### The Burst Dam.

IT is understood that the failure of a small portion of the dam at Bradfield, referred to in my main letter, will postpone for a short period the utilisation of the pumping scheme. At the time of the accident pumping operations had already been stopped for the winter months, in view of the fact that the upland reservoirs were being replenished by the rainfall at a sufficient rate to ensure by natural means the required legal flow in the river Don without the assistance of the sewage effluent.

A NEW LIGHTMETER.—A new instrument, known as the Holophane lightmeter, which is a portable instrument designed for the measurement of foot-candles, Lamberts, candles per square inch, candle-power, coefficients of reflection, transmission factors, and for colour matchings, has been introduced by the engineering department of the Holophane Glass Company, of 342, Madison-avenue, New York. The instrument is composed of a photometric head, a lamp battery, a rheostat, switch, and a milliammeter. The photometric head is an aluminium casing which contains a modified Lummer-Brodhun cube. The pattern given is that of two concentric ellipses, which are viewed through the adjustable focus telescope, and the action of the cube is to allow the light reflected from the test object to pass directly through the telescope to the observer's eye, whilst the light from the standard lamp is reflected at a right angle and then also passes through the telescope to the eye. The outer ellipse shows the light from the standard lamp, whilst the inner ellipse shows the light from the test object. In order to make foot-candle-power measurements, a test plate is placed on the plane from which measurements are required, and the plate is viewed through the telescope. The milliammeter indicates when the proper current is passing through the standard lamp, and the instrument is then adjusted until the two ellipses in the photometric field appear, when viewed through the eye-pieces, to have the same brightness. The foot-candles are then read directly from a scale.

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| N W. COAST— | |
| Native | 37/- |
| (1) Spanish | 28/- |
| (1) N. African | 28/- |
| N.E. COAST— | |
| Native | — |
| Foreign (c.i.f.) | 26/6 |

## PIG IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| (2) SCOTLAND— | | |
| Hematite | 5 15 0 | — |
| No. 1 Foundry | 5 12 6 | — |
| No. 3 ,, | 5 7 6 | — |
| N.E. COAST— | | |
| Hematite Mixed Nos. | 5 0 0 | 5 0 0 |
| No. 1 | 5 2 6 | 5 2 6 |
| Cleveland— | | |
| No. 1 | 4 15 0 | 5 0 0 |
| Siliceous Iron | 4 15 0 | 5 0 0 |
| No. 3 G.M.B. | 4 10 0 | 4 15 0 |
| No. 4 Foundry | 4 7 6 | 4 7 6 |
| No. 4 Forge | 4 2 6 | 4 2 6 |
| Mottled | 4 0 0 | 4 0 0 |
| White | 4 0 0 | 4 0 0 |
| MIDLANDS. | | |
| Staffs.— | | |
| All-mine (Cold Blast) | 11 10 0 | — |
| Part Mine Forge | *None offering.* | |
| North Staffs. Foundry (*Nom.*) | 5 0 0 | — |
| (3) Northampton— | | |
| Foundry Nos. 2 and 1 | *Nominal.* | |
| ,, No. 3 | 4 5 0 to 4 7 6 | |
| ,, Forge | 4 0 0 | — |
| (3) Derbyshire— | | |
| No. 3 Foundry | 4 10 0 | — |
| Forge | 4 0 0 to 4 2 6 | |
| (3) Lincolnshire— | | |
| Basic | 4 5 0 to 4 7 6 | |
| Foundry | 4 12 6 to 4 15 0 | |
| Forge | 4 5 0 to 4 10 0 | |
| (4) N.W. COAST— | | |
| N. Lancs. and Cumb. | | |
| Hematite Mixed Nos. | 6 5 0 | — |

## MANUFACTURED IRON.

| | Home. £ s. d. | Export £ s. d. |
|---|---|---|
| SCOTLAND— | | |
| Crown Bars | 12 10 0 | — |
| Best ,, | 17 0 0 | — |
| N.E. COAST— | | |
| Common Bars | 12 10 0 | — |
| Marked ,, | 18 0 0 | — |
| Tees | 14 10 0 | — |
| LANCS.— | | |
| Crown Bars | 13 0 0 | — |
| Hoops | 16 5 0 | 16 0 0 |
| S. YORKS.— | | |
| Crown Bars | 13 0 0 | — |
| Best ,, | 14 0 0 | — |
| Hoops | 16 0 0 | — |
| MIDLANDS— | | |
| Marked Bars (Staffs.) | 16 0 0 | — |
| Crown Bars | 12 0 0 to 13 0 0 | |
| Nut and Bolt Bars | 12 0 0 to 12 5 0 | |
| Gas Tube Strip | 13 10 0 | — |
| Hoops (*Nom.*) | 16 10 0 | — |

## STEEL.

| | (6) Home. £ s. d. | (7) Export. £ s. d. |
|---|---|---|
| (5) SCOTLAND— | | |
| Boiler Plates | 14 0 0 | — |
| Ship Plates ¾in. and up | 10 10 0 | — |
| Sections | 10 0 0 | — |
| Steel Sheets ⅛in. to ⅜in. | 12 5 0 | — |
| Sheets (Gal. Cor. 24 B.G.) | — | 16 10 0 |

## STEEL (*continued*)

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| N.E. COAST— | | |
| Ship Plates | 10 10 0 | — |
| Angles | 10 0 0 | — |
| Boiler Plates | 16 0 0 | — |
| Joists | 10 10 0 | — |
| Heavy Rails | 9 10 0 | — |
| Fish-plates | 14 10 0 | — |
| Channels | 14 10 0 | — |
| Hard Billets | 9 10 0 | — |
| Soft Billets | 7 10 0 | — |
| N.W. COAST— | | |
| BARROW— | | |
| Heavy Rails | 9 10 0 | — |
| Light ,, | 11 0 0 to 13 0 0 | |
| Billets | 9 5 0 | — |
| Ship Plates | 10 10 0 | — |
| Boiler ,, | 14 10 0 | — |
| MANCHESTER (*Prices irregular and uncertain, unchanged*)— | | |
| Bars (Round) | 10 0 0 to 12 0 0 | |
| ,, (others) | 11 0 0 to 12 0 0 | |
| Hoops (Best) | 15 5 0 | 15 0 0 |
| ,, (Soft Steel) | 12 5 0 | 12 0 0 |
| Plates | £10 to 12 | 10 0 0 |
| ,, (Lancs. Boiler) | 16 0 0 | — |
| SHEFFIELD— | | |
| Siemens Acid Billets | 11 0 0 to 13 0 0 | |
| Bessemer Billets | 12 0 0 | — |
| Hard Basic | 10 0 0 | — |
| Soft ,, | 8 0 0 to 9 0 0 | |
| Hoops | 12 5 0 | — |
| Soft Wire Rods | 11 0 0 | — |
| MIDLANDS— | | |
| Small Rolled Bars | 10 0 0 | — |
| Bessemer Billets | 7 15 0 to 8 0 0 | |
| Hoops | 12 0 0 to 12 10 0 | |
| Gas Tube Strip | 10 15 0 | — |
| Sheets (24 W.G.) | 13 10 0 to 14 0 0 | |
| Galv. Sheets (f.o.b. L'pool) | 16 10 0 to 17 10 0 | |
| Angles | 9 10 0 to 10 0 0 | |
| Joists | 10 10 0 | — |
| Tees | 11 0 0 | — |
| Bridge and Tank Plates | 9 10 0 to 10 10 0 | |

## NON-FERROUS METALS.

| | |
|---|---|
| SWANSEA— | |
| Tin-plates, I.C., 20 by 14 | 19/3 to 19/9 |
| Block Tin (cash) | 163 7 6 |
| ,, (three months) | 165 0 0 |
| Copper (cash) | 65 2 6 |
| ,, (three months) | 65 17 6 |
| Spanish Lead (cash) | 23 2 6 |
| ,, (three months) | 23 2 6 |
| Spelter (cash) | 26 2 6 |
| ,, (three months) | 26 10 0 |
| MANCHESTER— | |
| Copper, Best Selected Ingots | 68 0 0 |
| ,, Electrolytic | 73 0 0 |
| ,, Strong Sheets | 98 0 0 |
| ,, Loco Tubes | 0 1 2½ |
| Brass Loco Tubes | 0 1 0½ |
| ,, Condenser | 0 1 3½ |
| Lead, English | 25 0 0 |
| ,, Foreign | 24 0 0 |

(*Metal prices practically unchanged*).

## FERRO ALLOYS.

(*All prices now nominal*).

| | Per Ton. | Per Unit |
|---|---|---|
| Tungsten Metal Powder | 1/8 per lb. | |
| Ferro Tungsten | 1/5 per lb. | |
| Ferro Chrome, 4 p.c. to 6 p.c. carbon | £26 | 10/- |
| ,, 6 p.c. to 8 p.c. ,, | £25 10 0 | 9/- |
| ,, 8 p.c. to 10 p.c. ,, | £24 10 0 | 8/- |
| ,, Specially Refined | | |
| Max. 2 p.c. carbon | £75 | 26 6 |
| ,, 1 p.c. ,, | £91 | 31/- |
| ,, 0·75 p.c. carbon | £110 | 37/6 |
| ,, carbon free | 2/1 per lb. | |
| Metallic Chromium | 5/1 per lb. | |
| Ferro Manganese | (per ton) £15 for home. | |
| ,, Silicon, 45 p.c. to 50 p.c. | £12 0 0 scale 5/- per unit | |
| ,, ,, 75 p.c. | £21 10 0 scale 6/- per unit | |
| ,, Vanadium | 21/- per lb. | |
| ,, Molybdenum | 7/- per lb. | |
| ,, Titanium (carbon free) | 1/3 per lb. | |
| Nickel (per ton) | £180 | |
| Cobalt | 14/- per lb. | |
| Aluminium (per ton) | £110 to £120 (British Official). | |

## FUELS.

| | Export. |
|---|---|
| **SCOTLAND.** | |
| LANARKSHIRE— | |
| (f.o.b. Glasgow)—Steam | 23/- |
| ,, ,, Ell | 22/6 |
| ,, ,, Splint | 24/- to 28/- |
| ,, ,, Trebles | 26/- |
| ,, ,, Doubles | 23/- |
| ,, ,, Singles | 18/- |
| AYRSHIRE— | |
| (f.o.b. Ports)—Steam | 23/- |
| ,, ,, Splint | 24/- |
| ,, ,, Trebles | 26/- |
| FIFESHIRE— | |
| (f.o.b. Methil or Burntisland)—Steam | 20/- to 23/6 |
| Screened Navigation | 28/- |
| Trebles | 26/- |
| Doubles | 23/- |
| Singles | 18/6 |
| LOTHIANS— | |
| (f.o.b. Leith)—Best Steam | 22/6 |
| Secondary Steam | 22/- |
| Trebles | 26/- |
| Doubles | 23/6 |
| Singles | 18/6 |
| **ENGLAND.** | |
| (8) N.W. COAST— | |
| Steams | 34/- |
| Household | 40/- to 55/- |
| Coke | 31/- |
| NORTHUMBERLAND— | |
| Best Steams | 23/6 to 24/6 |
| Second Steams | 21/6 to 22/- |
| Steam Smalls | 14/- |
| Unscreened | 21/6 |
| Household | 25/- to 30/- |
| DURHAM— | |
| Best Gas | 21/6 to 22/- |
| Second | 20/- to 21/- |
| Household | 25/- to 30/- |
| Foundry Coke | 32/- to 33/- |
| SHEFFIELD— **INLAND.** | |
| S. Yorks. Best Steam Hards | 24/- to 25/- |
| Derbyshire Hards | 23/- to 24/- |
| Seconds | 22/- to 23/- |
| Cobbles | 22/- to 23/- |
| Nuts | 21/- to 22/- |
| Washed Smalls | 17/- to 18/- |
| Best Hard Slacks | 17/6 to 18/6 |
| Seconds ,, | 17/- to 17/6 |
| Soft Nutty ,, | 17/- to 17/6 |
| Pea ,, | 11/6 to 12/6 |
| Small ,, | 9/- to 10/- |
| House, Branch | 39/- to 41/- |
| ,, Best Silkstone | 37/6 to 39/- |
| Blast Furnace Coke (Inland and Export) | 22/6 to 27/6 |

| | (9) SOUTH WALES. |
|---|---|
| CARDIFF— | |
| Steam Coals: | |
| Best Smokeless Large | 24/6 to 25/- |
| Second ,, ,, | 24/- to 24/6 |
| Best Dry Large | 24/6 to 25/- |
| Ordinary Dry Large | 24/- to 24/6 |
| Best Black Vein Large | 23/- to 23/6 |
| Western Valley ,, | 22/6 to 23/- |
| Best Eastern Valley Large | 22/6 to 23/- |
| Ordinary ,, ,, | 21/6 to 22/6 |
| Best Steam Smalls | 17/6 to 18/6 |
| Ordinary ,, | 12/6 to 17/6 |
| Washed Nuts | 27/6 to 35/- |
| No. 3 Rhondda Large | 27/6 to 30/- |
| ,, ,, Smalls | 19/- to 20/- |
| No. 2 ,, Large | 22/- to 23/- |
| ,, ,, Through | 19/- to 21/- |
| ,, ,, Smalls | 15/- to 16/- |
| Coke (export) | 32/6 to 35/- |
| Patent Fuel | 25/- to 27/6 |
| Pitwood (ex ship) | 29/- to 30/- |
| SWANSEA— | |
| Anthracite Coals: | |
| Best Large | 55/- to 57/6 |
| Seconds | 45/- to 50/- |
| Red Vein | 40/- to 45/- |
| Big Vein | 50/- to 52/6 |
| Machine-made Cobbles | 72/6 to 75/- |
| Nuts | 72/6 to 75/- |
| Beans | 55/- to 57/6 |
| Peas | 20/- to 21/- |
| Breaker Duff | 7/6 to 7/9 |
| Rubbly Culm | 10/- to 11/- |
| Steam Coals: | |
| Large | 24/- to 25/- |
| Seconds | 23/- to 24/- |
| Smalls | 12/6 to 16/- |
| Cargo Through | 20/- to 22/- |

(1) Delivered (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

# French Engineering Notes.

*(From our Correspondent in Paris.)*

### The Trade Situation.

THE return to France of the rich mineral deposits and the metallurgical industry of Lorraine and the possession, for a certain period at least, of the Saar coal basin have provided some compensation for the devastation of the industrial region in the Nord, and the country is now far richer in natural resources than it was before the war. Our French friends are inclined to overlook these advantages and to point to the devastated areas as an example of how much France has suffered, and to insist that the work of restoration should be carried out before anything is done to effect an economic reconstitution elsewhere. So far as France is concerned, the international aspect of the question is of secondary importance, for the amount of work to be done in the country is enormous, and apart from the reconstruction work the undertakings sanctioned for railway improvements, harbour extensions, hydro-electric installations, inland waterways, colonial development and other enterprises will involve an expenditure of something like 40,000 million francs. The funds necessary for carrying out these vast schemes are not available, and there is little hope at present of much progress being made without the money which Germany was to have paid, some of which has already been discounted by advances which the State has been making for reconstruction work. The idea of accepting part of the payment in kind was to procure from Germany such machinery and goods as may be necessary for equipping the country, and especially the colonies, to assist in their industrial development. The scheme is not popular, for French manufacturers fear that the way will be left open for flooding the market with German goods that may be prejudicial to their interests. These reasons are sufficient to explain the attitude of the French over the question of reparation, and it is quite conceivable that if they could carry out their programme France would enter upon a period of prosperity that might reflect upon other countries

### Continuous Brakes.

The obligation imposed upon railway companies to fit continuous brakes to goods trains has necessitated, first of all, the selection of a suitable system. For some months past tests have been carried out under particularly arduous conditions with the Clayton-Hardy, Westinghouse and Lipkowski systems of brakes, and apparently the results have not been uniformly satisfactory, although little will be known of the relative merits of the different systems, as judged by the trials, until the official report is published. Meanwhile, the question has arisen whether the selection of a definite type will involve other countries, for an international commission existed at Berne before the war to ensure uniformity of types on the Continent, and, under the Treaty of Versailles, Germany was required to adopt the system of continuous brakes employed by the Allies. As the result of experiments made during the war Germany in 1917 adopted the Kunze-Knorr continuous brake, which since then has extended to Austria, Sweden and Norway, and it is reported that trials are now being carried out with the German system in Italy and in the Balkan States. The Kunze-Knorr continuous brake seems therefore likely to be standardised nearly everywhere on the Continent before the French have been able to select a system. It is now stated that a French group has secured the Kunze-Knorr rights for France, which means that the German continuous brake for goods trains will be brought into direct competition with the three systems now being tested. The situation will become complicated if the French railway companies refuse to accept the German system, which apparently is in a fair way of becoming the standard for the Continent.

### Wages Reductions.

Having failed to come to terms with the miners over the question of a reduction in wages the colliery owners in the Nord and the Pas de Calais announced that from Monday last wages would be reduced 2.50f. a day, and that a further similar reduction would be imposed on April 1st next. The men replied by demanding an increase proportionate to the higher cost of living. They further asked for a delay which the coalowners refused, on the ground that under the present conditions of the coal trade they must either reduce the wages bill or shut down the pits. They offer to prove that with the present high wages, shorter working day and lower individual output the collieries are being run at a loss. The men's unions have been endeavouring to work up an agitation for a strike, but previous failures have shown the majority of the men that they have nothing to gain by coming out when they can see no reasonable hope of a successful issue, and there is a general impression that the miners will eventually accept the wages reduction.

### Wagons.

The wagon builders will doubtless find plenty of employment as soon as the railway companies are able to give out orders for the renewal of much of their present defective rolling stock, for while the requirements are heavy the companies have been obliged to hold back considerable contracts until the financial position becomes more satisfactory. Meanwhile, there is little being done in the wagon building shops, some of which have been obliged to undertake a variety of work to keep the men employed, and builders have been sending in very close estimates for foreign orders. In no case, however, have they been able to get near the prices quoted by Belgian and other firms, and for an order for 180 wagons for Brazil, the work was secured by the Société Belge de Matériel de Chemins de Fer of La Croyère, the tender of which was the lowest submitted by twenty-four firms. The highest tender was sent in by a British concern. In view of the repeated failures to secure foreign orders there is a question of French locomotive and wagon builders combining to see if something can be done to get prices down to a level that will give them a chance of competing successfully with Belgian and other firms.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

*Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

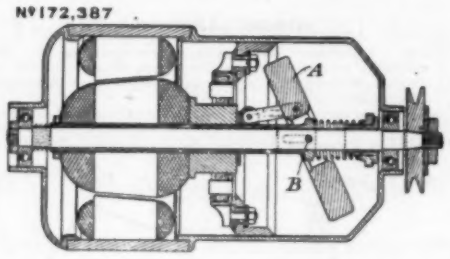
*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

## DYNAMOS AND MOTORS.

172,387. September 2nd, 1920.—IMPROVEMENTS IN SELF-REGULATING DYNAMOS, Henry Hughes Smith, of Sutton Park Hotel, Boldmere-road, Wylde Green, near Birmingham, and Thomas Guy Percy Healey, of 191, Boldemere-road, Wylde Green, near Birmingham.

This invention is more or less self-explanatory. The longitudinal displacement of the coned armature gives the necessary voltage regulation which is required in consequence of variations in speed. Normally, the spiral spring thrusts the armature

N°172,387



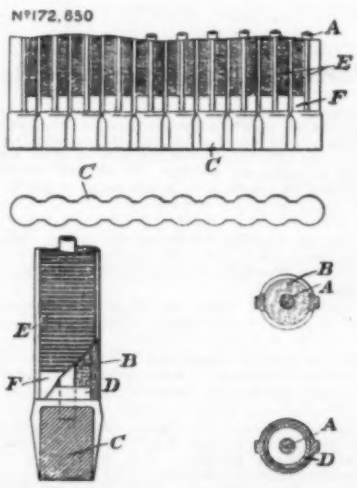

inwards, but when the speed increases, the centrifugal governor A, which is pivoted on a pin B, takes up a more vertical position and draws the armature outwards. The sleeve which carries the armature is slotted so as to allow it to move backwards and forwards in the manner described.—*December 2nd*, 1921.

## BATTERIES AND ACCUMULATORS.

172,850. December 22nd, 1921.—IMPROVEMENTS IN SECONDARY BATTERY PLATES OR ELECTRODES, The Chloride Electrical Storage Company, Limited, of Clifton Junction, near Manchester.

The metal rods A are surrounded by active material B, and C is a bar which connects the rods A together and is provided with annular projections D. Around the rods slotted or ribbed tubes

N°172,850



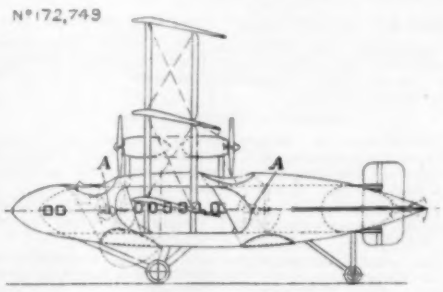

E are placed, and at the ends these tubes are provided with plain extensions F which fit over the projections D and butt on to the bars C. As the walls of these extensions are solid, they effectively strengthen the ends of the tubes.—*December 22nd*, 1921.

## AERONAUTICS.

172,749. September 21st, 1920.—AEROPLANES, Sir William Beardmore, and A. Galbraith, Naval Construction Works, Dalmuir, Dumbarton, N.B.

The inventors propose to improve the rising and alighting qualities of aeroplanes by arranging some of the engines, such as those at A A, on trunnions, so that they may be tilted to

N°172,749



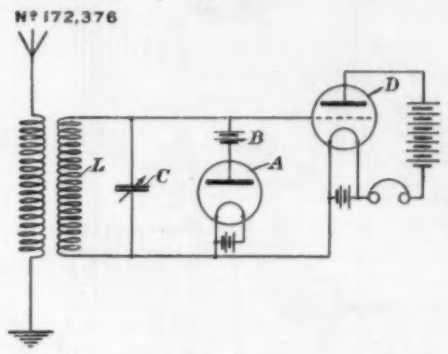

produce a more or less vertical thrust. The trunks in which these engines were arranged would have doors at the bottom that would be opened as the engines were tilted. With the engines in the horizontal, or travelling, position, the doors would be closed and the discharge from their screw propellers would be directed aft by passages in the body of the machine.—*December 21st*, 1921.

## WIRELESS TELEGRAPHY.

172,376. August 13th, 1920.—IMPROVEMENTS IN AND RELATING TO RADIO RECEIVING SYSTEMS, John Scott-Taggart and Radio Communication Company, Limited, of 34–35, Norfolk-street, W.C. 2.

This invention relates to limiting and controlling oscillations in radio receiving circuits. The diagram shows a receiver working in accordance with the invention. A valve A is connected across the circuit L C, a battery B giving the anode of the valve

N° 172,376



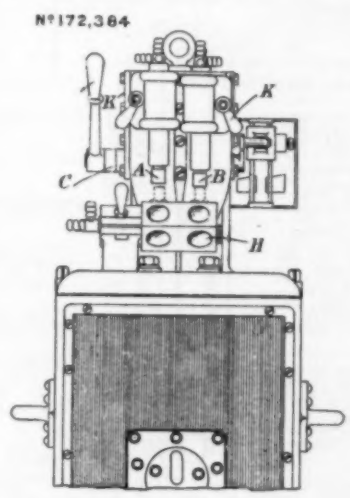

A a negative potential. The second valve D acts as a detector of the oscillations in the circuit L C. The shunt formed by the valve A is non-conductive to weak currents, but conducts when the currents are above a predetermined amplitude, and therefore lessens interference.—*November 30th*, 1921.

## ELECTRICAL APPLIANCES.

172,384. September 1st, 1920.—IMPROVEMENTS IN OR RELATING TO ELECTRIC RIVET HEATING MACHINES, James Moll, of 64, Heinrich Beck Strasse, Chemnitz, Saxony.

The electrodes between which the rivets are placed are connected to a transformer in the usual way, and the upward and downward movements of the top electrodes A and B are controlled by a shaft C upon which cams are so mounted that when the handle on the left is placed in the raised position one electrode is raised whilst the other is lowered. A cold rivet placed in the machine is gripped by the latter

N°172,384



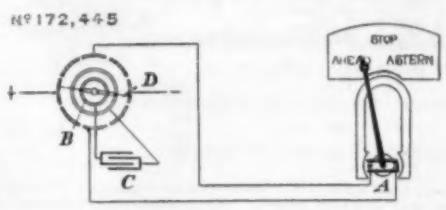

electrode, whilst the former releases the heated rivet. Both the electrodes are water cooled. The handle also actuates a switch in such a way that the current passing through the heated rivet is interrupted before the upper electrode pressing on that rivet is raised, and after the other electrode has been lowered on to the rivet to be heated the circuit is again completed. To enable the machine to deal with rivets of different lengths the movable electrodes can be raised or lowered by slackening the screws at K. There is also a revolving device H, with openings for different-sized rivet heads.—*December 1st*, 1921.

## TESTING AND MEASURING INSTRUMENTS.

172,445. September 21st, 1920.—IMPROVED ELECTRICAL MEANS FOR INDICATING AT A DISTANCE THE DIRECTION OF MOTION OF AN APPARATUS, Evershed and Vignoles, Limited, of Acton-lane, Chiswick, W. 4, and John Cuthbert Needham, of Acton-lane Works, Chiswick, W 4.

A polarised indicator A is connected to a commutator B, which is connected in turn to a direct-current supply and a condenser C in the manner shown. The direction of the current discharge through the indicator depends on the direction of

N°172,445

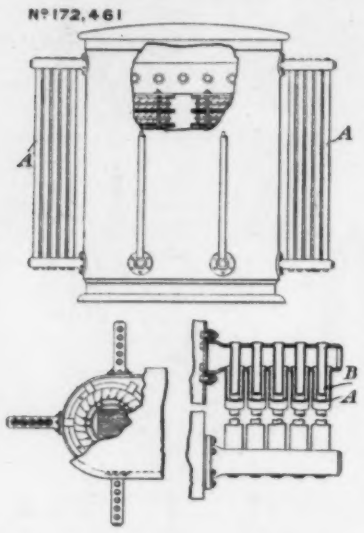



rotation of the brush arm D, and the indicator therefore shows the direction in which an engine or other shaft is rotating. If the driving shaft stops rotating, the condenser loses its charge, and the indicator takes up the "stop" position.—*December 15th*, 1921.

## TRANSFORMERS.

172,461. September 30th, 1920.—IMPROVEMENTS IN AND RELATING TO CASINGS FOR ELECTRICAL AND OTHER APPARATUS, The British Thomson-Houston Company, of 83, Cannon-street, E.C. 4.

The accompanying drawing shows this invention applied to the case of a transformer. The oil within the casing is cooled

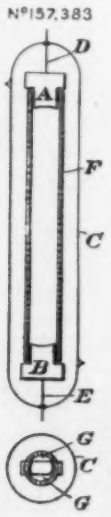



by the radiating pipes shown at A. The heated oil passes down the space between the pipes A and B, where it is cooled by air currents in the pipe B. It then passes to the lower header and back to the casing.—*December 15th*, 1921.

## LIGHTING AND HEATING.

157,383. January 10th, 1921.—IMPROVEMENTS IN ELECTRIC GAS-FILLED GLOW DISCHARGE LAMPS, Anton Lederer, of 83, Atzgersdorf, Vienna, Austria.

The two electrodes A and B are held in the vessel C by means of the conductors D and E, and are inserted into the ends of the luminous tube F. The electrodes A and B are flattened on two

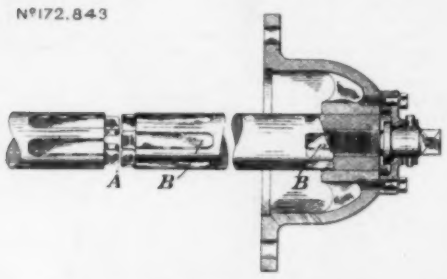



opposite sides, as shown in the lower drawing, so that passages G are provided to give communication between the interior of the luminous tube F and the glass vessel C. A circulation of the gas takes place continuously through the passages G at the ends of the tube F.—*December 22nd*, 1921.

## MOTOR CARS AND ROAD TRAFFIC.

172,843. November 5th, 1920.—DIFFERENTIAL LOCKING GEAR, The Vulcan Motor and Engineering Company (1906), Limited, and E. G. Grinham, Crossens, Southport.

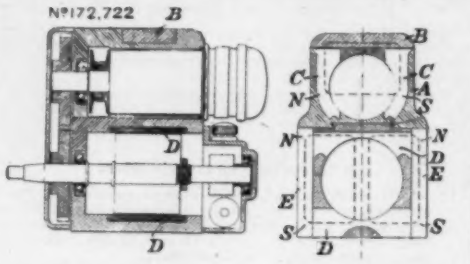
For the purpose of locking the differential gear of vehicles to give a positive drive by both wheels when travelling over soft ground, the inventors provide the two half-axles with castella-




tions, as shown at A, and splines B B for connecting the differential gear and road wheels. The castellations are engaged, or disengaged, by moving either one, or both, half-axles endways by the screw gear shown on the right.—*December 22nd*, 1921.

172,722. September 11th, 1920.—IMPROVEMENTS IN AND RELATING TO MAGNETO ELECTRIC MACHINES, the British Thomson-Houston Company, Limited, of 83, Cannon-street, E.C. 4, and Arthur Primrose Young, of "Dovedale," Kenilworth, Warwickshire.

This invention relates to a combined magneto and electric generator. The magneto is mounted on top of the generating unit, as shown, the two armatures being geared together. The

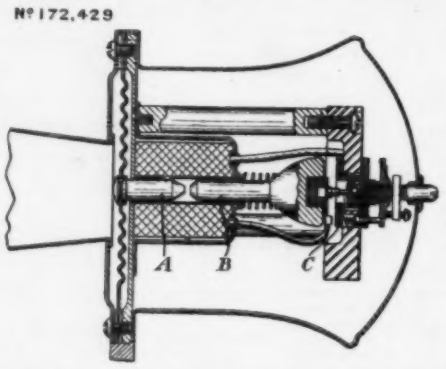



casing A is composed of aluminium. B is a magnet having laminated pole pieces C. The rotor of the generator unit revolves between laminated pole pieces D, which are bridged by magnets E.—*December 12th*, 1921.

## MISCELLANEOUS.

172,429. September 15th, 1920.—IMPROVEMENTS IN AND RELATING TO ELECTRICALLY OPERATED WARNING SIGNALS, Daniel McGregor, of 49, Sampson-road, Sparkbrook, Birmingham.

As shown in the drawing, the diaphragm of this electric warning device is fitted with a pin A, which projects into the solenoid. When current is passed round the coil of the solenoid the arma-




ture B is drawn inwards against the action of the spiral spring and strikes the pin A. The circuit is made and broken intermittently at the contacts C.—*December 15th*, 1921.

# Forthcoming Engagements.

***Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.***

### TO-DAY.

INSTITUTE OF TRANSPORT.—Royal Society of Arts, John street, Adelphi. Graduates' and Students' Lecture. "The Operation of an Important Railway Goods Terminal," by Mr. G. T. Hedge. 5 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Royal Technical College, George-street, Glasgow. "Centrifugal Castings," by Mr. F. E. Hurst. 7 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Mappin Hall, University of Sheffield. "An Investigation of Some Defects in Silver-plating Anodes," by Messrs. F. C. Robinson and H. G. Dale. 7.30 p.m.

THE INSTITUTION OF CIVIL ENGINEERS, BIRMINGHAM AND DISTRICT ASSOCIATION; THE INSTITUTION OF MECHANICAL ENGINEERS, MIDLAND DISTRICT; THE INSTITUTION OF ELECTRICAL ENGINEERS, SOUTH MIDLAND DISTRICT.—Council House, Birmingham. Joint discussion on "The Electrification of Main-line Railways." Speakers: Messrs. Wm. Willox, C. F. Bengough, H. N. Gresley, J. A. Hookham, R. T. Smith, F. W. Carter. 7 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse on "Soap Films and Molecular Forces," by Sir James Dewar. 9 p.m.

ASSOCIATION OF ENGINEERING AND SHIPBUILDING DRAUGHTSMEN: MERSEYSIDE BRANCH.—Walker Engineering Building, The University of Liverpool. Lecture, "The Tides," by Professor J. Prowdman. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, S.W. "Some Observations on a Producer Gas Power Plant," by Messrs. H. S. Denny and N. V. S. Knibbs. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Caxton Hall, S.W. Lecturette, "Geology in its relation to Engineering." 8 p.m.

### FRIDAY AND SATURDAY, JANUARY 20TH AND 21ST.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS: SOUTH-WESTERN DISTRICT.—At Council Chamber, Plymouth. At 3 p.m. on Friday. Saturday's programme will be devoted to a series of excursions.

### MONDAY, JANUARY 23RD.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. Informal meeting. Discussion, "Electrical Vehicles: Present and Future," to be opened by Mr. R. J. Mitchell. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, S.W. 1. Paper, "Airships," by Mr. F. Arnold Best. 7 p.m.

BRADFORD ENGINEERING SOCIETY.—Hall of Bradford Technical College. Lecture on "The Protection of Industrial Invention," by Mr. J. V. Armstrong. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE SECTION.—Hotel Metropole, Leeds. Paper, "Reinforced Concrete Water Tower at York," by Messrs. W. H. Humphreys and J. Gilchrist. 7.30 p.m.

THE PETTER ENGINEERING SOCIETY.—Petter's Institute, 28, Kingston, Yeovil. Lecture, "The Marketing of an Engineering Product," by Mr. P. W. Petter. 8 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN SECTION.—Armstrong College, Newcastle. "The Interconnection of Alternating-current Power Stations," by Messrs. L. J. Romero and J. B. Palmer. 7.15 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi. Cantor Lecture I., "Inks," by Mr. C. A. Mitchell. 8 p.m.

### TUESDAY, JANUARY 24TH.

THE NEWCOMEN SOCIETY.—Caxton Hall, Westminster. Paper, "Mechanics of Engineering from the Time of Aristotle to that of Archimedes," by Dr. T. E. Lones. 5 p.m.

INSTITUTE OF INDUSTRIAL ADMINISTRATION.—Great Hall, London School of Economics, Aldwych, W.C. Lecture, "Industrial Economics in relation to the Bearing on National Welfare of the Ascertainment of Cost," by Mr. J. M. Felbs. 8 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-WESTERN CENTRE.—Engineers' Club, Manchester. "The Cye-Arc Process of Automatic Electric Welding," by Messrs. L. J. Steele and H. Martin. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS: NORTH-EASTERN SECTION.—Electrical Engineering Theatre, Armstrong College, Newcastle-on-Tyne. Paper, "Pyrometry," by Mr. R. L. Granville Johnston. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: EAST MIDLAND SUB-CENTRE.—The College, Loughborough. "Loughborough Electricity Undertaking and Extensions in Hand," by Mr. R. B. Leach. 6.45 p.m.

WOMEN'S ENGINEERING SOCIETY.—Club Room, 26, George-street, Hanover-square, W. Lecture, "Domestic Engineering," by Miss Gwynne Howell. 6.15 p.m.

THE INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Papers to be further discussed: "Control of Trains in Relation to Increased Weight and Speed Combined with Reduced Headway," by Mr. Alan Wood Rendell; "Trials in Connection with the Application of the Vacuum Brake for Long Freight Trains," by Sir Henry Fowler, K.B.E., and Mr. Herbert Nigel Gresley. 6 p.m.

### WEDNESDAY, JANUARY 25TH.

INSTITUTION OF CIVIL ENGINEERS: STUDENTS' SECTION.—Great George-street, S.W. 1. Lecture, "The Economic Aspects of Various Methods of Power Transmission," by Mr. E. W. Monkhouse. 6 p.m.

INDUSTRIAL LEAGUE AND COUNCIL.—Caxton Hall, S.W. "Conditions of Industrial Harmony," by Mr. F. Hughes. 7.30 p.m.

THORNYCROFT ENGINEERING SOCIETY.—Works Canteen, Basingstoke. "Electrical Efficiency," by Mr. Swarbrick. 7 p.m.

WEST BROMWICH ENGINEERING SOCIETY.—Technical School, West Bromwich. "Small Lighting Sets," by Mr. W. Wilson. (Lantern.) 7.30 p.m.

### THURSDAY, JANUARY 26TH.

INSTITUTION OF ELECTRICAL ENGINEERS: TEES-SIDE SUB-CENTRE.—Cleveland Technical Institute, Middlesbrough. "Methods of Conversion of Alternating Current to Direct Current for Traction Purposes," by Mr. C. H. Davidson. 7 p.m.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. Students' meeting. Paper, "Practical Points in Fuselage Construction," by Mr. Colin Daniel. 7 p.m.

THE CONCRETE INSTITUTE.—Denison House, 296, Vauxhall Bridge-road, S.W. Paper, "Capillary Canals in Concrete and the Percolation of Water Through Them," by Mr. E. B. Moullin. (Lantern.) 7.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Caxton Hall, S.W. 1. Paper, "Notes on the Influence of Design on Express Locomotive Performance," by Mr. Cecil J. Allen. 7.15 p.m.

### FRIDAY, JANUARY 27TH.

JUNIOR INSTITUTION OF ENGINEERS.—Caxton Hall, S.W. Lecturette, "Fuels and the Boiler-house," by Mr. L. M. Jookel. 8 p.m.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—The Engineers' Club, Coventry-street, W. Smoking concert and informal dinner. 7 p.m.

ROYAL SOCIETY OF ARTS: INDIAN SECTION.—John-street, Adelphi, W.C. 2. "The Timbers of India and Burma," by Mr. A. L. Howard. 4.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse on "Journalism," by Viscount Burnham. 9 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Lecture Theatre, Literary and Philosophical Society, Newcastle-on-Tyne. "Marine Diesel and Marine Oil Engines," by Mr. K. O. Keller. 6.30 p.m.

ASSOCIATION OF ENGINEERING AND SHIPBUILDING DRAUGHTSMEN: MERSEYSIDE BRANCH.—University Engineering Building, Liverpool. "Micro-structures of Metal and What They Mean to Engineers," by Mr. E. A. Atkin. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: IRISH CENTRE.—Royal College of Science, Dublin. Lecture, "The Development of Electricity Supply in Switzerland," by Mr. E. M. Johnson. 8 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Memorial Hall, Albert-square, Manchester. Paper, "Organisation of Production," by Mr. J. W. Curtis. 7 p.m.

### SATURDAY, JANUARY 28TH.

INSTITUTION OF CIVIL ENGINEERS.—Students' Visit to the Central Telegraph Office of the General Post Office. 10 a.m.

### TUESDAY, JANUARY 31ST.

INSTITUTION OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—Paper on "Tidal Power Development," by Professor A. H. Gibson, D.Sc. 6.30 p.m.

ILLUMINATING ENGINEERING SOCIETY.—Royal Society of Arts, John-street, Adelphi. Discussion, "The Use of Light as an Aid to Aerial Navigation," to be opened by Lieut.-Colonel L. F. Blandy. 8 p.m.

### THURSDAY, FEBRUARY 2ND.

LIVERPOOL ENGINEERING SOCIETY.—Exchange Station Hotel, Liverpool. Annual dinner. 7 p.m. for 7.30 p.m.

### FRIDAY, FEBRUARY 3RD.

JUNIOR INSTITUTION OF ENGINEERS.—Caxton Hall, S.W. "Utilisation of Waste Heat from Internal Combustion Engines, by Major W. Gregson. (Lantern.) 8 p.m.

### THURSDAY AND FRIDAY, MAY 4TH AND 5TH.

IRON AND STEEL INSTITUTE.—Institution of Civil Engineers, Great George-street, S.W. 1. Annual meeting. Annual dinner, Thursday, May 4th, at Connaught Rooms, Great Queen-street, W.C.